SERVICE MANUAL

CRYOSTAT MICROTOME

HM 505 E
From ser. no. 17657 up

MICROM International GmbH
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391 080 - English

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Part 1 Introduction

This Service Manual is a guide for troubleshooting, field repair and maintenance of the

Cryostat Microtome HM 505 E

This Service Manual (cat. no. 391080) should be used along with the Instruction Manual (cat. no. 386240) of the HM 505 E. It is important that the service technician reads and understands the Instruction Manual before using this Service Manual.
Errors and ommissions excepted. Subject to amendment.

Issued on: June 19, 2006

WARRANTY!

This MICROM product is warranted against defects in material and workmanship for a period of 1 year. Parts which prove to be defective during the warranty period will be repaired or replaced free of charge by MICROM International GmbH. No other warranty is expressed or implied. Unauthorized modification or repair by third party persons will void the warranty.
The warranty will expire in case of improper or wrong use of the instrument and in case the warning and precautionary messages are not observed. MICROM International GmbH is not liable for any occurring damage.

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Part 2 Description of the Cryostat Microtome HM 505 E

The cryostat HM 505 E from MICROM International GmbH is a highly efficient microtome cryostat for a cutting temperature range down to - 35°C. Designed as an upright standing unit with an open-top working area, the instrument allows convenient and ergonomic handling in standing and sitting position.
The cryostat has a cooling system to control the temperature of the working area of the microtome and knife carrier as well as to cool the freezing stations for freezing-on specimens onto the specimen chucks.
Further optional accessories for the HM 505 E is the heat extractor as well as the active deep freezing device.

The instrument is equipped with an automatic 24-h-defroster with interrupt key.

The rustproof microtome has a section thickness range from 1 µm to 500 µm divided into section thicknesses and trimming thicknesses. For the protection of knife and specimen, the instrument retracts the specimen at the end of the cut. The motorized coarse feed system allows specimen forward and backward travel. This way specimen and knife edge distance can be adjusted quickly. Moreover, the automatic approach system guarantees a fast and exact adjustment between specimen and knife edge. An additional trimming function with values from 10 µm to 500 µm permits the fine adjustment up to the first cuts and results in larger section thicknesses when trimming.
Two knife carriers are available. The standard knife carrier is designed so the knives can be easily clamped in place and adjusted. The disposable blade holder EC takes up high and low profile blades. The corresponding anti-roll guides facilitate taking off sections.
Section counter, sum of section thicknesses and remaining travel to the front end position are indicated on the display of the operating panel.
In addition the instrument is equipped with a handwheel brake.

2-1 Accessories

2-1-1 Standard equipment

The cryostat microtome HM 505 E is supplied with the following accessories:

2	Specimen chucks, 30 mm round	715110
1	Specimen chuck, 40 mm round	715120
6	Cover caps for freezing stations	402500
1	Hex head wrench 5 mm	362450
1	Hex head wrench 6 mm	362430
1	Brush 8 - 10 mm	334160
1	Bottle cryostat oil no. 407, 100 ml	350040
1	Bottle freezing medium, 100 ml for low and medium temperatures	350100
1	Handwheel handle	424100
1	Section waste tray	502160
1	Brush shelf	502110
1	Centering grip to align the orienting specimen holding device	424210
1	Screwdriver	362270
1	Instruction manual	386240

2-1-2 Additional equipment, optional

2-1-2-1 Knife carrier — Cat. No.

Standard knife carrier	705460
Anti-roll plate	532520
Disposable blade carrier EC	705470
Anti-roll plate	532770

2-1-2-2 Additional accessories

Heat extractor	524500
Specimen chuck, ∅ 30 mm	715110
Specimen chuck, ∅ 40 mm	715120
Specimen chuck, 50 x 50 mm	715170
Specimen chuck, 55 x 55 mm	715180
Specimen chuck, 60 x 55 mm	715190
Specimen chuck, 70 x 55 mm	715450
Cover caps for freezing stations	402500

2-1-2-3 Accessories for sectioning paraffin

Standard specimen clamp	546130
Universal cassette clamp	546060
Fixed adapter for mounting standard specimen clamp and universal cassette clamp	532040

2-1-2-4 Accessories for TT specimen chuck system

Rear adapter top for TT specimen chuck system	449330
Clamping device for rectangular TT specimen chuck	715520

PART 3 TECHNICAL DATA HM 505 E

Cooling of microtome chamber (at +20°C ambient temp.)	Temperature range	+5°C to -35°C
		resolution 1°C
	Automatic defrosting	1 each 24 h
Microtome:	Section thickness range	1 - 500 µm
	Fine section thickness range	1 - 20 µm
	Resolution	1 µm for 1 - 10 µm
		2 µm for 10 - 20 µm
	Trimming thickness range:	10 - 500 µm
	Resolution:	10 µm for 10 - 80 µm
		20 µm for 80 - 100 µm
		50 µm for 100 - 300 µm
		100 µm for 300 - 500 µm
	Specimen retraction during return travel	40 µm
	Horiz. feed range	28 mm
	Vertical specimen stroke	64 mm
Section counter:	Five-digit LED display with reset	
Sum of section thicknesses:	Five-digit LED display with reset	
Remaining travel to front end position:	Five-digit LED display	
Size of specimen chucks:		30, 40, 50, 55, 60, 70 mm
		special sizes upon request
Specimen orientation:	x - and y - axes:	universal 8°
	z - axis:	up to 360°
Cutting drive:		manual by means of handwheel
Coarse feed:		motorized, graduated and continuous
Microtome chamber illumination, heated sliding window		
Storage temperature range:		-20°C to +50°C
Operating conditions:		+5°C to +40°C (at a max. humidity of 60%)
		altitude up to 2000 m M.S.L.
		for indoor use only
Power requirements:		100V/12 A +/-10% 50 - 60 Hz
		110V/12 A +/-10% 50 - 60 Hz
		115V/12 A +/-10% 50 - 60 Hz
		120V/12 A +/-10% 50 - 60 Hz
		127V/12 A +/-10% 50 - 60 Hz
		200V/6 A +/-10% 50 - 60 Hz
		220 - 230V/6 A +/-10% 50 - 60 Hz
		240V/6 A +/-10% 50 - 60 Hz

Continued on page –2-

Pollution degree:	2
Overvoltage category:	II
Dimensions:	775x800x1200 mm (wide/deep/high)
Weight:	135 kg

Part 4 Theory of design and operation

4-1 Application

Before sectioning, the cooling chamber should be at a stable temperature around the desired cutting temperature. The temperature of the knife, specimen clamp and specimen is determined by the cooling of the cooling chamber.

All tools which are necessary to take off sections or to manipulate the specimen must also be cooled, as the section will stick to them. For this reason, the required working accessories should always be stored on the shelves or brush tray in the cooling chamber.

The heated sliding window should be closed during breaks and while preparing work to avoid warm air getting into the chamber. Consequently, more favorable work conditions with a lower frost built-up on the microtome and knife are achieved.

The specimen is frozen-on to the specimen chuck with clinging grooves with a freezing compound.
To freeze-on specimens, use the six fast freezing stations on the left side of the cooling chamber. When the fast freezing stations are not being used, cover them with the cover caps. This way, frost or ice built-up on the fast freezing stations can be avoided.

When using the fast freezing device, put some freezing compound onto the specimen chuck, which should be outside the cooling chamber at a low positive temperature. Then put the specimen on the chuck and surround it with some freezing compound.
Then insert the specimen chuck into one of the six fast freezing stations. The specimen and freezing compound are quickly frozen evenly.

If the instrument is equipped with the optional active deep freezing device, there are eight fast freezing stations in the cooling chamber. The four front ones are actively cooled. Start the function <deep freezing> in due time before freezing-on the specimen. It will take approx. 2 - 3 min. until the active deep freezing device reaches a temperature of -55°C.

If the instrument is equipped with a heat extractor (additional equipment), the specimen can be frozen faster and more evenly. Put the pre-cooled heat extractor onto the specimen from above. This way, the specimen is frozen at the same time from above and below, which reduces the formation of artefacts considerably.

Clamp the specimen chuck together with the frozen specimen into the specimen holder. Tighten the orienting lever in a clockwise direction. Loosen the clamping lever to have the possibility to adjust the specimen parallel in relation to the cutting edge via the orienting lever. Then press the clamping lever backwards.

With the motorized coarse feed, specimen and knife edge can roughly be adjusted. Then carry out a further gradual feed by using the function <trimming>. Turn the handwheel in a clockwise direction resulting in the first contact between knife and specimen. Continue this thus achieving the desired level. Any waste should be wiped away in an upward direction with a brush.

4-2 Mechanical design

The cryostat HM 505 E consists of a cooling chamber equipped with a cryo-microtome, a refrigeration system to cool the chamber and an electronic control system to check and carry out all the functions that can be activated via the operating controls.

The individual functional groups are commonly installed into the main frame (fig. 2.3). The panels of the main frame, the top cover (fig. 1.1) and the heated sliding window (fig. 1.3) represent its outer appearance. The main frame is screwed to the foot part (fig. 2.7). Four rollers (fig. 2.10) are screwed to the bottom of the main frame. The front two rollers are steering rollers.

Figure 1 shows the design of the Cryostat HM 505 E.

CAUTION! Turn off the power switch and unplug the unit before removing or opening the covers!

If needed, move the instrument to have enough space for service and maintenance work. Loosen the locking screws, which are accessible through the hole (fig. 1.8), in a counter-clockwise direction.

To have access to the interior construction, remove the rear panel (fig. 2.4). For this, unscrew the Phillips screws with a Phillips screwdriver.
Before removing the two side panels (fig. 2.2 and 2.5), open the top cover (fig. 1.1) and dismount the handwheel (fig. 2.17) as follows:
Carefully remove the cover disk (fig. 2.20) by means of a flat screwdriver. Please note that the handwheel handle (fig. 2.18) is in the lower position to make sure that the horizontal cylinder of the microtome is also in the lower position. If not, the horizontal cylinder might slide downwards due to the missing counterweight of the handwheel. This can be dangerous while carrying out service work on the instrument.
Then unscrew the Allen screw (fig. 2.19) via an Allen key 6 mm and pull off the handwheel together with the brake.

To open the top cover (fig. 1.1), first open the sliding window and unscrew the two screws, which are placed on the front interior side of the top cover. Please note that the inserted distance washers do not fall into the interior of the instrument. Afterwards, close the sliding window again and tightly fix it with tape so that it does not slide downwards when opening the top cover. Now open the top cover and secure it by means of the holding support (fig. 2.24), which is placed on the left inside of the instrument.

Then remove the side panels (fig. 2.2 and 2.5) as follows: First loosen the two visible screws (fig. 2.21) on the outside of the instrument. Then loosen the two nuts (fig. 2.27) from the inside. Tilt the side panels and lift them out of the pegs (fig. 2.8).

Open the top cover (fig. 1.1) to get to the CPU board, display and touchpad keyboard, power board and the heated sliding window.

As described above, remove the rear panel (fig. 2.4) to have access to the electrochassis for fuses, valve, transformers, line filter, ballast and triac board.

To work on the drive support on the right side of the instrument, remove the right side panel (fig. 2.5). For this, first dismount the handwheel (fig. 2.17) as described above.

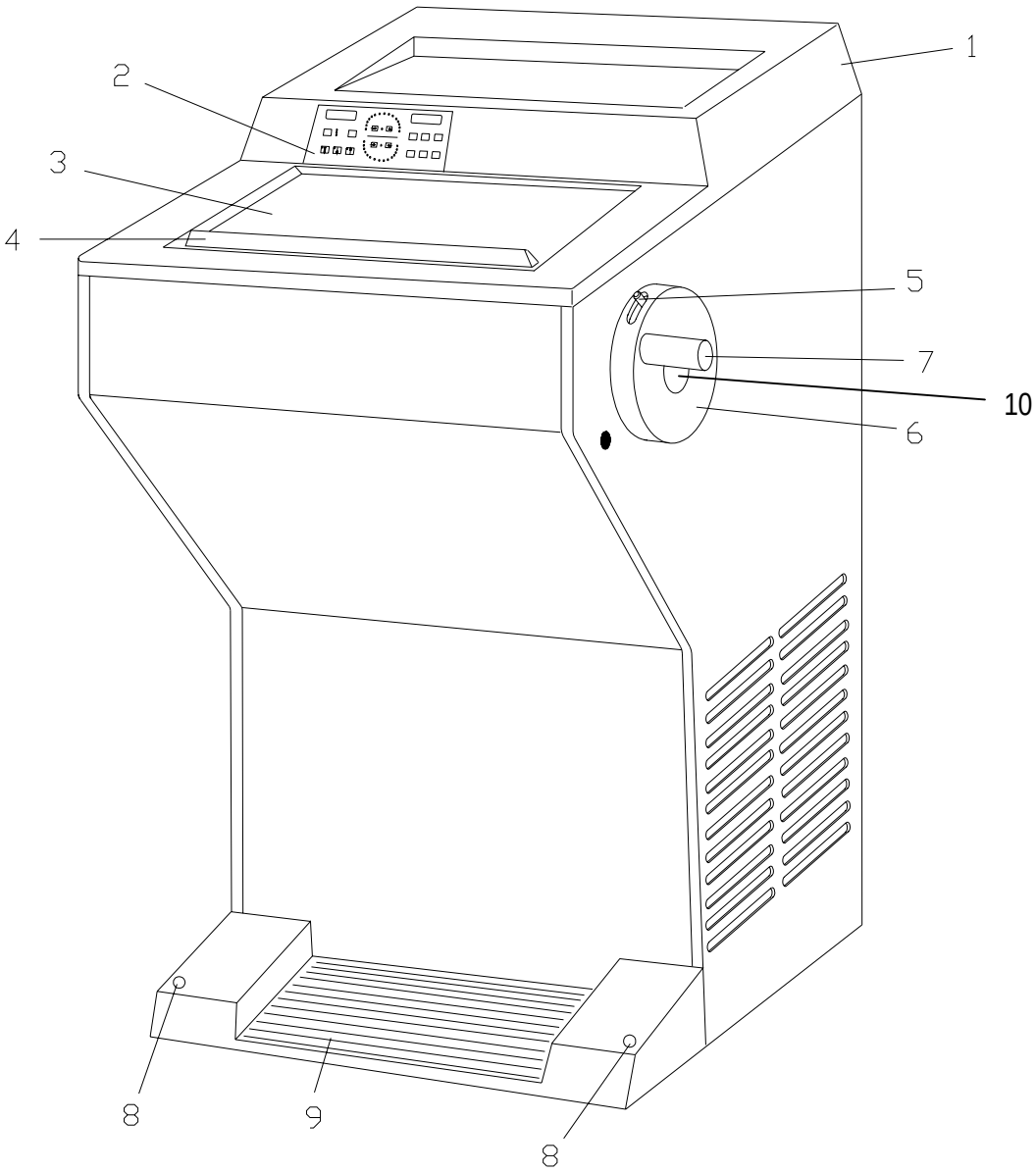

Fig. 1

1 = Top cover
2 = Tochpad keyboard
3 = Heated sliding window
4 = Grip f. sliding window
5 = Lever
6 = Handwheel
7 = Handle
8 = Hole for adjusting screws
9 = Rubber mat
10 = Cover disk

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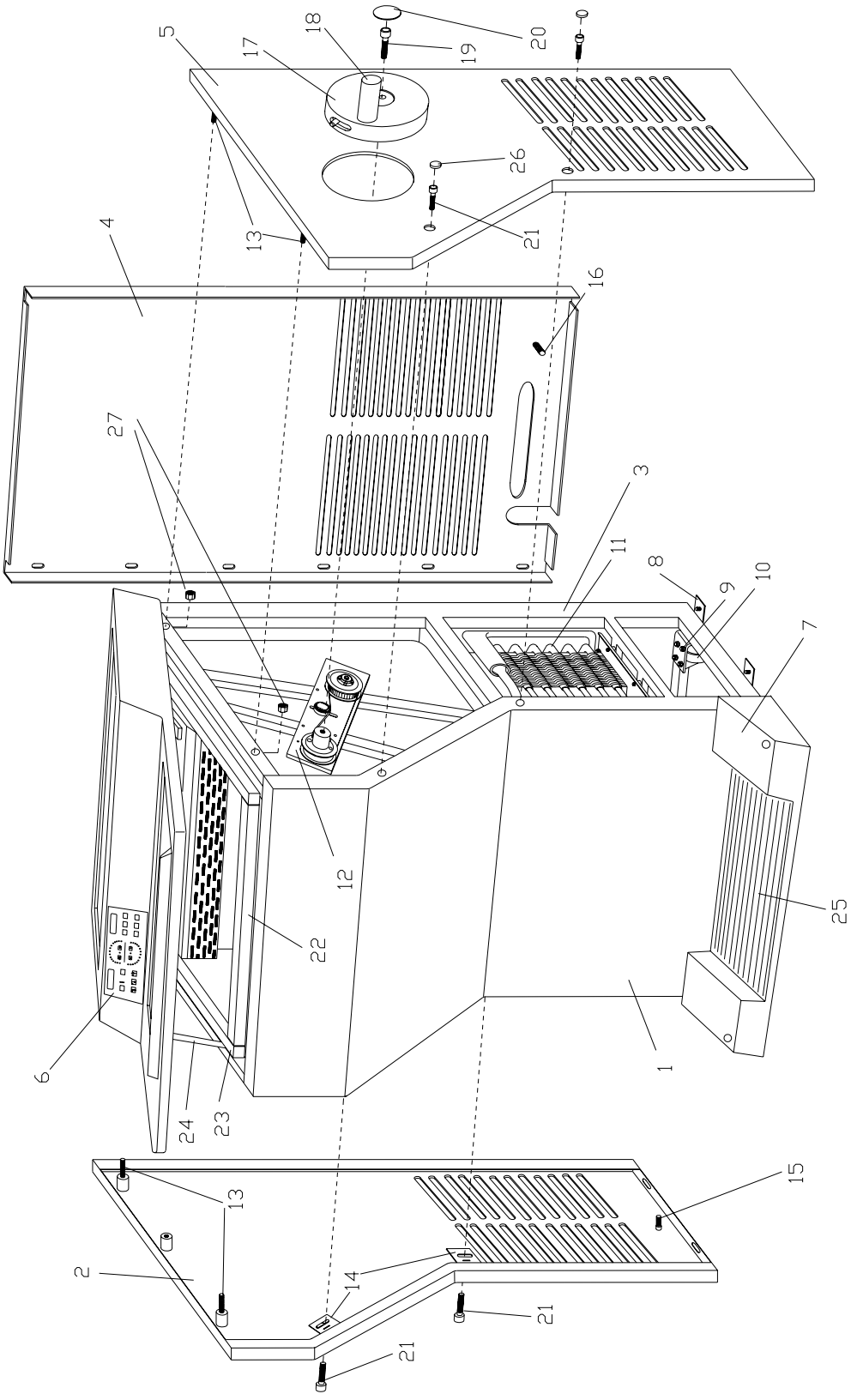

Fig. 2

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Descriptions for fig. 2

1 = Front panel
2 = Side panel, left
3 = Main frame
4 = Rear panel
5 = Side panel, right
6 = Touchpad keyboard
7 = Foot
8 = Fastening side panel
9 = Fastening roller
10 = Fixed roller
11 = Condenser
12 = Drive support
13 = Fastening side panel
14 = Fastening side panel
15 = Fastening safety ground
16 = Fastening safety ground
17 = Handwheel
18 = Handle
19 = Fastening handwheel
20 = Cover disk
21 = Fastening side panel
22 = Foamed material
23 = Foamed material
24 = Holding support
25 = Rubber mat
26 = Cover cap
27 = Nut

4-2-1 Microtome with retraction

The microtome of this cryostat is a rustproof rotary microtome. The cutting movement is carried out manually by turning the handwheel. The rotary driving movement results in the vertical movement of the specimen clamping. The specimen is moved up and downwards close to the knife edge. The knife is clamped securely into the knife carrier.

The section thickness feed is delivered at the upper reversal point of the vertical movement. The specimen holder together with the specimen moves to the front by the value of the section thickness, which can be selected on the control panel.
With the downward movement of the specimen, sectioning is carried out. During the return travel, the specimen is drawn back automatically to protect knife and specimen, which means that the knife can be used longer and that the specimen is protected against artefacts.

The number of sections made is indicated on the section counter and can be shown on the display of the control panel.
The sum of sections made, multiplied with the selected section thickness, can also be seen on the display. For this, trimming values and sectioning values are added up. Section counter and sum of section thicknesses can be reset to zero at any time by means of the RESET-button.
Moreover, the remaining travel to the front end position can also be shown on the display. The remaining travel, which is still available for sectioning, is shown in microns.

Figure 3 shows the cryo rotary microtome. The monobloc (fig. 3.15) with cylinder guide is vertically moved up and downwards on zero-backlash cross roller bearings (fig. 3.12). The drive of the vertical cutting movement is carried out by the rotating driving axle (fig. 3.11) which is placed in the double bearing of the flange (fig. 3.10). On the inner side of the driving axle (fig. 3.11), a crank arm (fig. 4.5) with an eccentric bolt (fig. 4.1) is situated. This bolt is inserted into the link block (fig. 4.2), which glides horizontally in a slide hook (fig. 4.4). This slide hook is inserted into a horizontal groove of the monobloc (fig. 4.3). This way, the rotary movement of the driving axle (fig. 3.11) leads to the vertical up and downward movement of the monobloc (fig. 4.3).

The horizontal section thickness feed, trimming thickness feed as well as the coarse feed movement and the retraction movement are activated by moving the horizontal cylinder (fig. 22.2) in the cylinder guide (fig. 4.3) of the monobloc (fig. 3.15). The two guide wedges prevent the horizontal cylinder from twisting. The two guide wedges are installed on the bottom of the monobloc (fig. 3.15). They glide in the groove (fig. 22.3) of the horizontal cylinder.

Moving the cylinder is carried out by the precision nut, which is solidly screwed into the cylinder. A precision spindle turns in the precision nut.
Referring to the spindle, the nut with counternut (fig. 5) is already adjusted free from backlash via springs. Pins are inserted to prevent the two nuts from twisting.

Figure 5 shows a cross section of the micrometer mechanism. The spindle (fig. 5.3) turns inside the nut with counternut (fig. 5.4 - 5.5), which is solidly screwed into the movable cylinder (fig. 19.1). The spindle (fig. 5.3) is arranged in the bearing disk (fig. 5.2) via two axial needle bearings (fig. 19.17), which are mounted together under tension.
The end of the spindle is connected with the stepping motor (fig. 20.14) via a multi-plate clutch (fig. 19.24).
A turning movement of the stepping motor leads to a turning of the spindle.

The coarse feed movement can be carried out in both directions (see specimen coarse feed and trimming stages, part 4-2-3).

The specimen retraction is carried out in the lower reversal point of the monobloc. When the monobloc is in the lower reversal point, a sensor plate (fig. 20.17) moves into the lower light barrier (fig. 20.18). The electronic gives an impuls to the stepping motor to carry out the turning movement of the spindle. This way, the horizontal cylinder is retracted by 40 µm.

When the monobloc is in the upper reversal point, the sensor plate (fig. 20.17) moves into the upper light barrier (fig. 20.19). This way, the stepping motor moves forwards by the retraction value as well as the feed value which was selected on the control panel.

Use a dial gauge holder in connection with a dial gauge to determine the retraction and feed value (see part 7, tools and equipment).

To insert specimen chucks, screw the orienting specimen head (fig. 3.17) to the four asymmetrically placed holes on the front side of the cylinder. If desired, the fixed adapter (cat. no. 532040) in connection with the fixed standard specimen clamp (cat. no. 546130) or the fixed universal cassette clamp (cat. no. 546060) can be used in the same way.

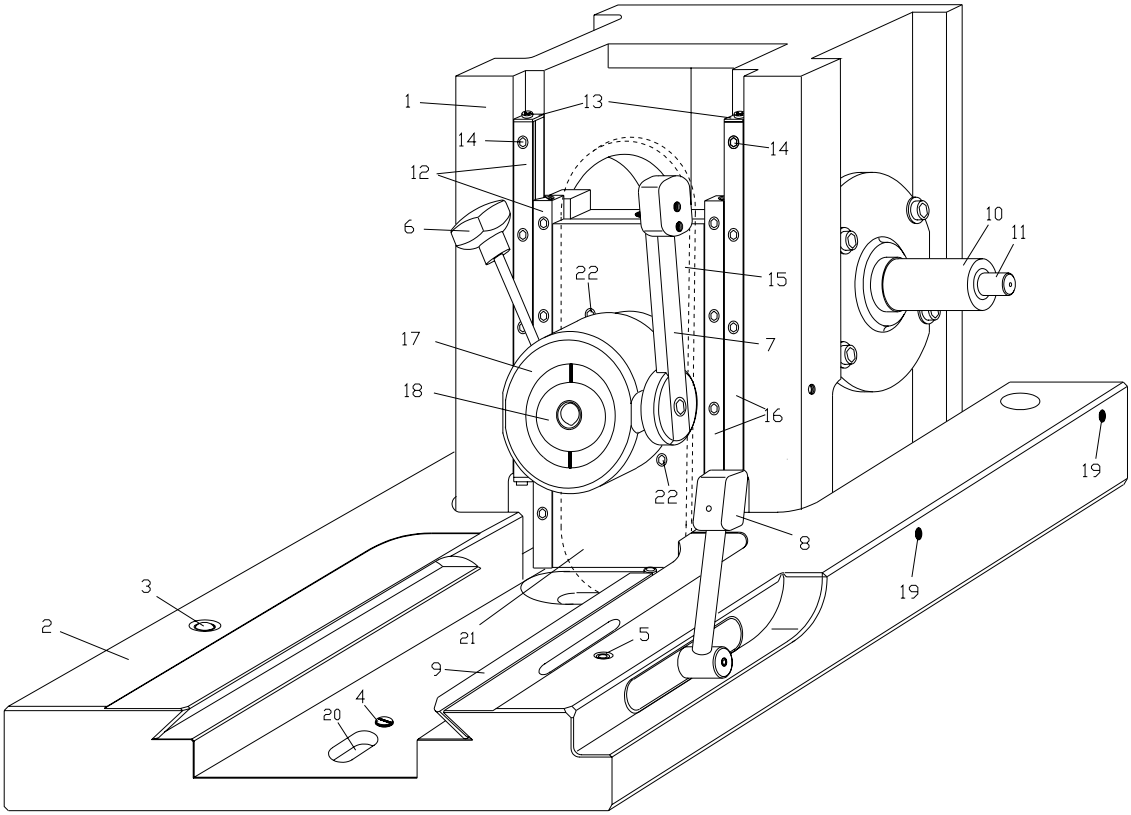
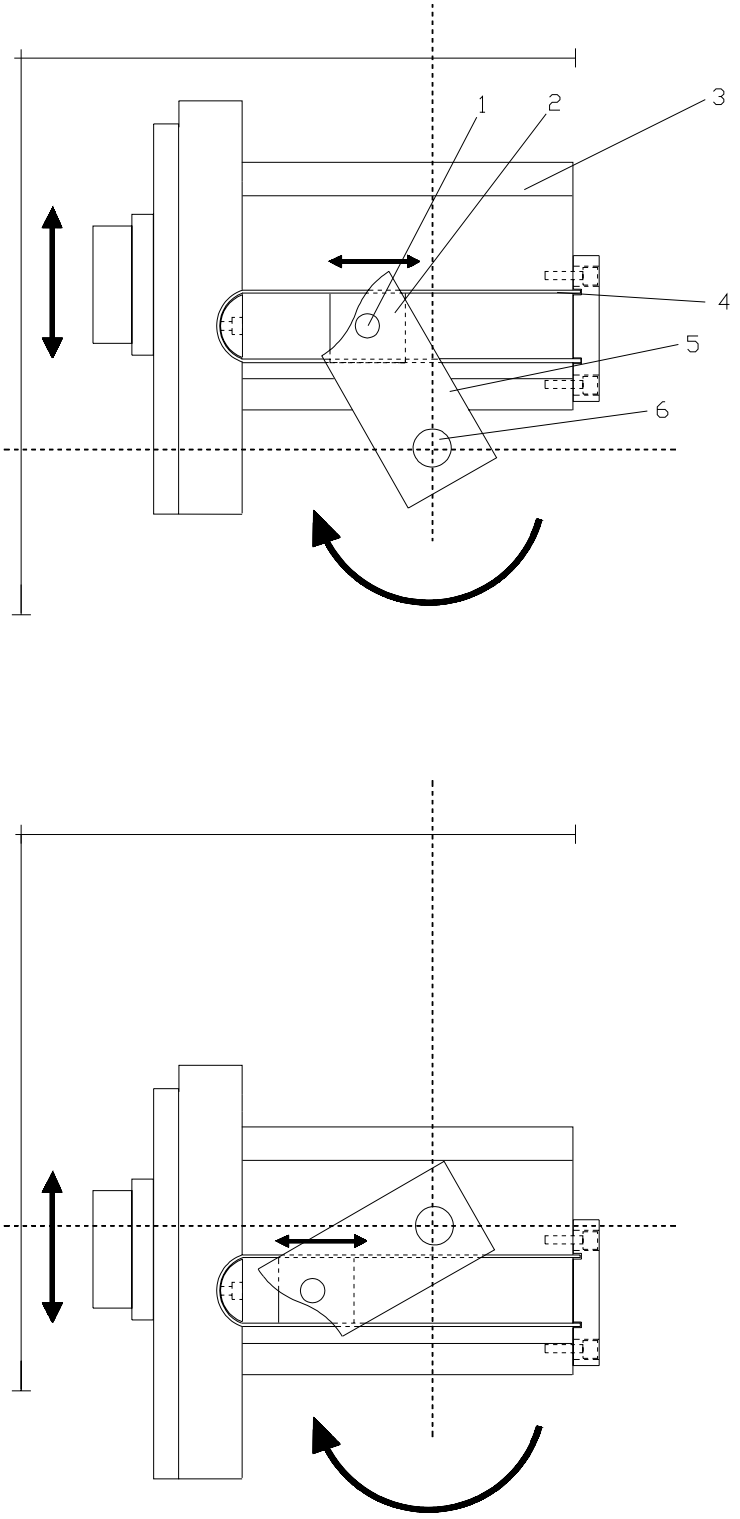


Fig. 3

1 = Frame
2 = Base plate
3 = Thrust piece
4 = Adjusting screw
5 = Threaded pin
6 = Star handle
7 = Lever
8 = Handle
9 = Clamping ledge
10 = Flange
11 = Shaft
12 = Cross roller bearings
13 = End pieces
14 = Fastening cross roller bearings
15 = Cylinder with guidance
16 = Cross roller bearings
17 = Cylinder head
18 = Ball piece
19 = Fastening housing
20 = Fastening microtome
21 = Shield
22 = Fastening shield



1 = Cylinder pin
2 = Link block
3 = Cylinder with guidance
4 = Slide hook
5 = Crank arm
6 = Shaft

Fig. 4

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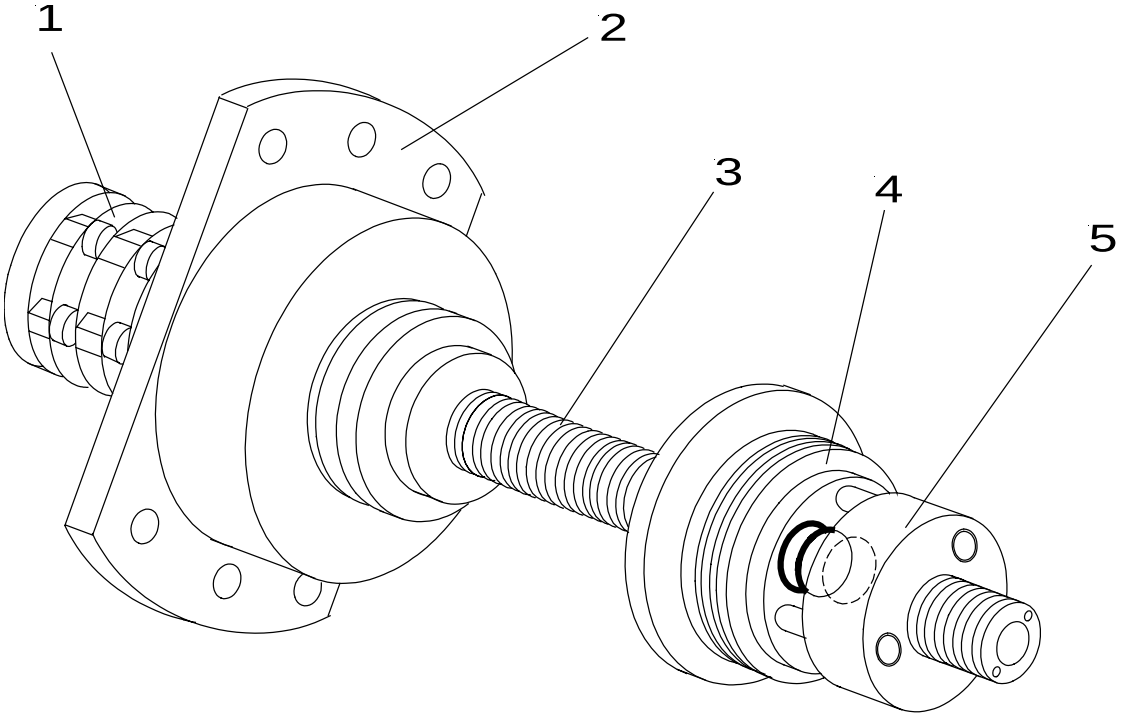


Fig. 5

1 = Flexible coupling
2 = Bearing disk
3 = Micrometer spindle
4 = Micrometer nut
5 = Counternut

4-2-2 Automatic approach system

The automatic approach system is used for the fast and exact approach of the specimen towards the knife edge.
The function of the automatic approach system is limited to the temperature range between -5°C and -35°C.
The automatic approach system uses the intrinsic capacity of the specimen to notice a first contact between specimen and knife edge. If specimen and knife edge get in contact with each other, a very low current is measured via a pre-amplifier, which is placed directly behind the specimen holder. The signal form of the detected current is transferred via the outlet of the pre-amplifier to the microprocessor. A corresponding software recognizes the threshold value causing an immediate interruption of the horizontal drive. The threshold value is also determined regarding the temperature.
The optimal function of the automatic approach system is based on the fact that the knife is conductively connected with the knife carrier base, whereas the specimen holder is separated by an insulating piece.

4-2-3 Specimen coarse feed, trimming stages

After changing the specimen, moving the knife or knife carrier, it is necessary to adjust the specimen to the knife edge again. This can easily be done by means of the specimen coarse feed and the defined trimming values.

To move the specimen holder electronically forwards or backwards, press the corresponding buttons on the control panel. After the specimen and knife are adjusted, further gradual feed for trimming can be carried out by using the function <trimming>. Whenever pressing the button <trimming>, the motorized feed is released. The same happens, when the function <trimming> is stored and the handwheel is turned.

The coarse feed movement is driven by the stepping motor and can be carried out in either direction.

The movement of the coarse feed is limited. When turning on the instrument, the cylinder (fig. 19.1) moves backwards, until a sensor plate (fig. 7.5) interrupts the light barrier (fig. 7.2). Consequently, the motor function for the coarse feed movement is interrupted and the instrument is in a certain calibration position.
The turning movement of the motor (fig. 20.14) changes and the horizontal cylinder moves forwards by a defined value. The left display on the control panel shows 28 000 µm, which are now available for feed movements. However, this figure is only shown on the display, when the indication for the remaining travel has been chosen.
No feed movements are carried out anymore, when the horizontal cylinder has reached 0 µm or when a feed movement, which is larger than the remaining travel, should be carried out. Then the front end position of the horizontal cylinder is reached.

The feed movement for the trimming stages is also carried out via the stepping motor. The trimming movement is activated by a defined pulse drive of the stepping motor. Values from 10 - 500 µm are available, which are achieved by corresponding pulses.

4-3 Electronic control

The enclosed block diagrams show the design of the control for the Cryostat HM 505 E.

The processor is placed on the CPU board (fig. 18.11). This board is connected to the control panel board (fig. 12) via a 34-lead flat cable. Inputs from the keyboard are read by the CPU board, while the values to be indicated are transmitted to the displays. The CPU board gets further inputs from the defrost cycle limiting sensor, from the temperature sensor for the cooling chamber and from the opto sensor board as well as from the automatic approach system.
In the opposite direction, the CPU board sends control signals to the various receiving units in the cryostat, i.e. the control power board and the triac board.
The CPU board (fig. 18.11) is connected with the triac board (fig. 6a.24) via a 5-lead wired connection, which is part of the 25-lead cable. The control signals are converted on the triac board and transmitted to the corresponding electronically controlled power switches for the various receiving units. The solid state relay to activate the illumination of the cooling chamber is placed directly on the triac board. The bypass valve is activated by a solid state relay on the triac board. The cooling valve is also activated by a solid state relay.
The stepping motor power control board (fig. 18.12) supplies the windings of the stepping motor (fig. 20.14), which drives all the horizontal feed movements.

The light barrier unit (fig. 21.2) transmits three signals to the CPU board. First, the rear end position of the horizontal specimen movement is determined by the light barrier (fig. 7.2), released by a sensor plate (fig. 7.5).
Second and third, the upper and lower reversal points of the vertical cutting movement are recognized by an upper (fig. 7.1) and a lower (fig. 7.4) light barrier and transmitted to the CPU board. For this, a sensor plate (fig. 7.3) enters by turns the upper and lower forks of the light barriers.

Via the power cord the supply voltage is connected to the two main fuses. The outputs of the fuses are then connected to the main terminal.
The compressor and parallel the fan for the condenser are supplied from the power input via the power contactor (fig. 6a.38). The power contactor is switched via the mains switch.
The primary sides of the transformers are supplied by the mains fuses F1 and F2, the line filter and the mains switch. Between the mains switch and each transformer, one more fuse is installed. Fuse F3 protects transformer T20 (fig. 6a.6) and fuse F5 protects the transformer T4A (fig. 6a.41).
Transformer T20 supplies the window heating (16 V) (fig. 1.3), the heating arm rest (24 V) and the triac board (12 V) (fig. 6a.24). Transformer T20 (fig. 6a.6) also supplies the CPU board with 24 V.
Transformer T4A supplies the CPU board and the keyboard with display with 11 V each.

4-3-1 Table of fuse-protected circuits

Fuse	Electric circuit
F1, F2	Mains fuses, entire instrument
F3	Transformer T20
F4	Illumination
F5	Transformer T4A
F6	Arm rest, valves, CPU board, 24 VAC
F7	Window heating, 16 VAC
F8	Supply triac board, 12 VAC
F9	Supply CPU board, 11 VAC
F10	Supply display keyboard, 11 VAC

4-3-2 Pin configuration of the cable connection to the microtome

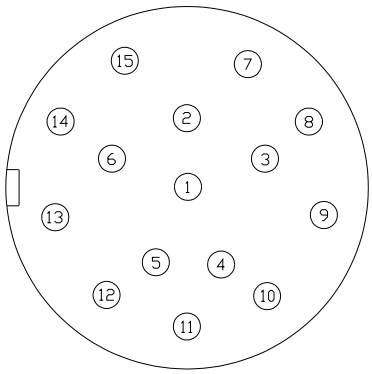
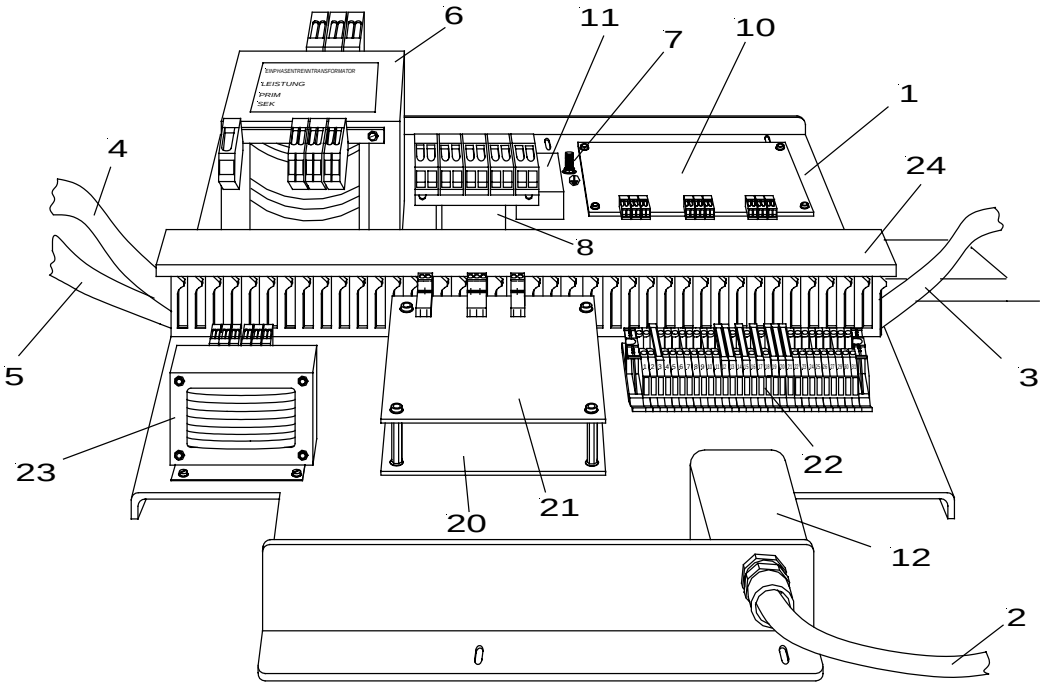


Fig. 6

Pin configuration of the male connector of the connecting cable (front view)

Pins 1 - 10 = Stepping motor 1- 10 (5 phases)
Pins 11 - 15 = Opto sensor board

Pin:			
1	yellow (Phase I)	11 = white/red:	GND
2	white (Phase I)	12 = white/orange:	Signal light barrier lower
3	blue (Phase 2)	13 = white/brown:	Signal light barrier upper
4	red (Phase 2)	14 = white/black:	Signal light barrier rear
5	orange (Phase 3)	15 = white/yellow:	5 VDC
6	green (Phase 3)		
7	grey (Phase 4)		
8	black (Phase 4)		
9	brown (Phase 5)		
10	violet (Phase 5)		



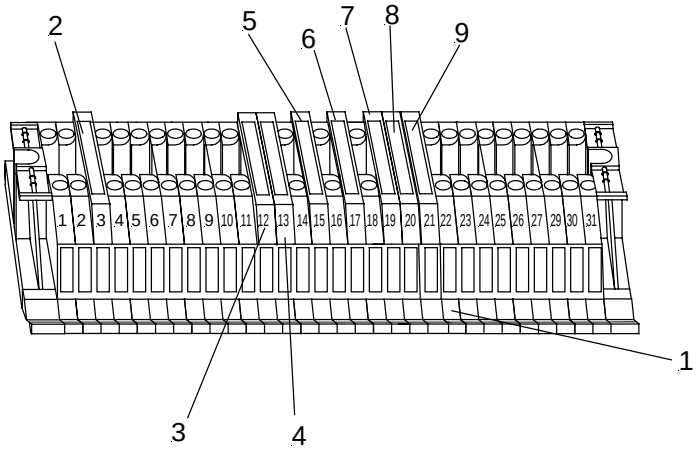
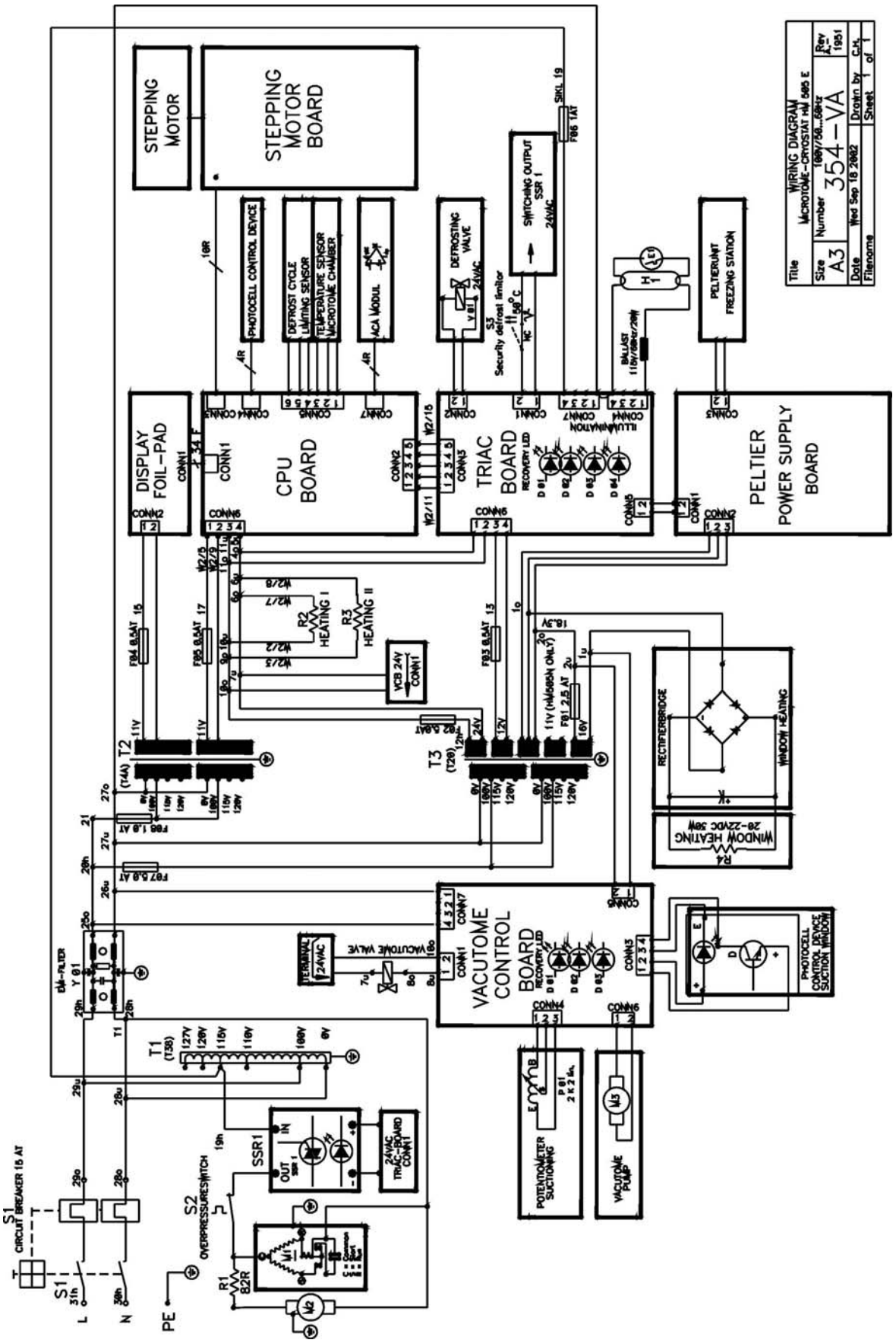


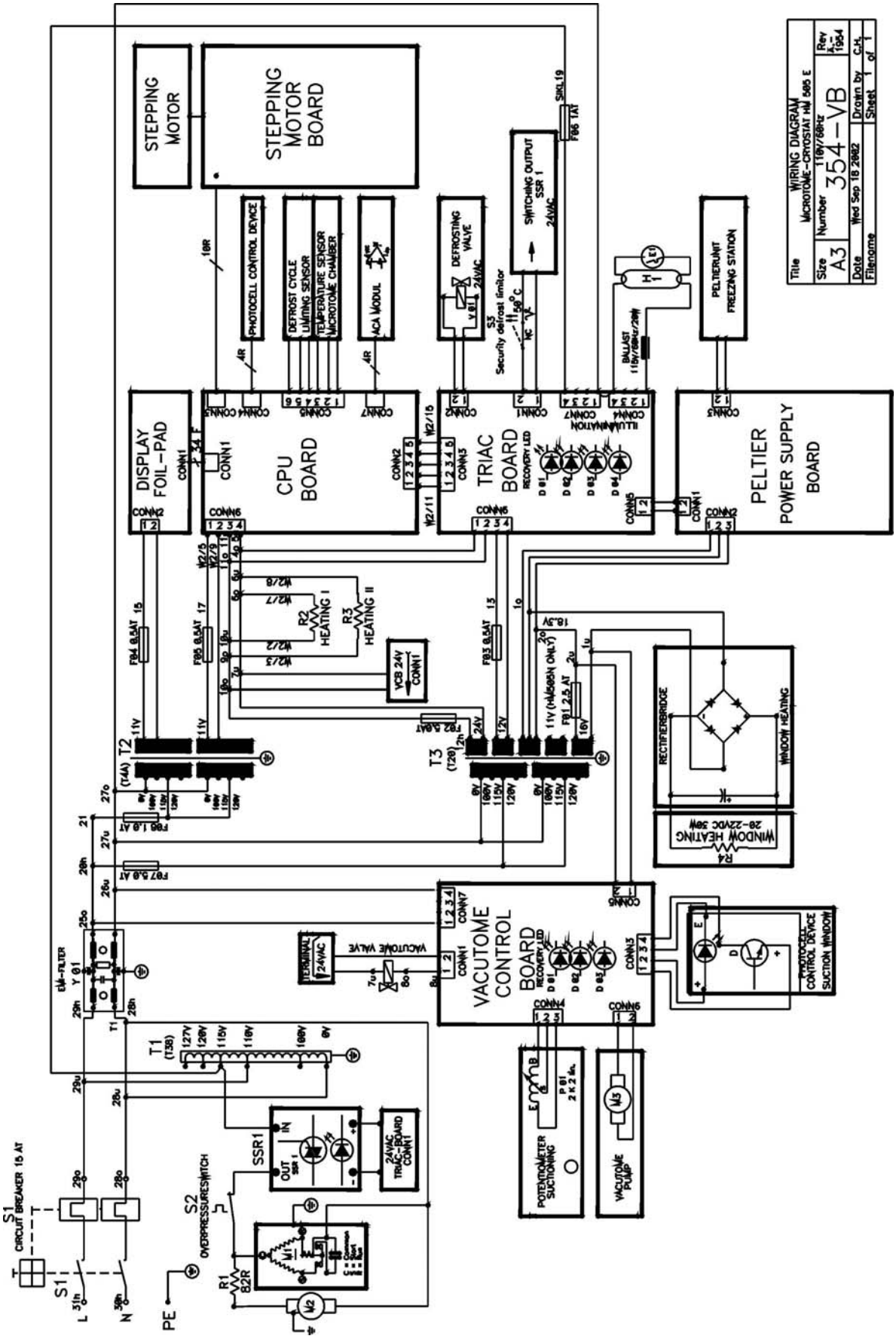
Fig. 6a

1 = Terminal block	Version 220 – 230 V, 240 V, 200 V	100 V, 110 V, 115 V, 120 V, 127 V
2 = Fuse, F 01	2,5 AT	2,5 AT
3 = Fuse, F 02	5,0 AT	5,0 AT
4 = Fuse, F 03	0,5 AT	0,5 AT
5 = Fuse, F 04	0,5 AT	0,5 AT
6 = Fuse, F 05	0,5 AT	0,5 AT
7 = Fuse, F 06	0,5 AT	1,0 AT
8 = Fuse, F 07	2,5 AT	5,0 AT
9 = Fuse, F 08	0,5 AT	1,0 AT

Descriptions for figure 6a

1 = Chassis
2 = Power cord
3 = Control cable for compressor
4 = Control cable for high voltage
5 = Control cable for low voltage
6 = Transformer T 20
7 = Ground connection (protective conductor)
8 = Transformer T 4a
10 = Vacutome control unit
11 = Relay
12 = Line filter
20 = Triac board
21 = Peltier board
22 = Terminal block
23 = Transformer T 39


STEPPING MOTOR
STEPPING MOTOR BOARD
PHOTOCELL CONTROL DEVICE
DEFROST CYCLE LIMITING SENSOR
TEMPERATURE SENSOR MACROTOME CHAMBER
ACA MODUL
DEFROSTING VALVE
SWITCHING OUTPUT SSR 1
PELTIERUNIT FREEZING STATION
WIRING DIAGRAM MACROTOME-CRYOSTAT HM 505 E
354-VA
DISPLAY FOIL-PAD
CPU BOARD
TRIAC BOARD
PELTIER POWER SUPPLY BOARD
VACUTOME CONTROL BOARD
WINDOW HEATING
VACUTOME VALVE
VACUTOME PUMP
POTENTIOMETER SUCTIONING
CIRCUIT BREAKER 16 AT
OVERPRESSURESWITCH
PE



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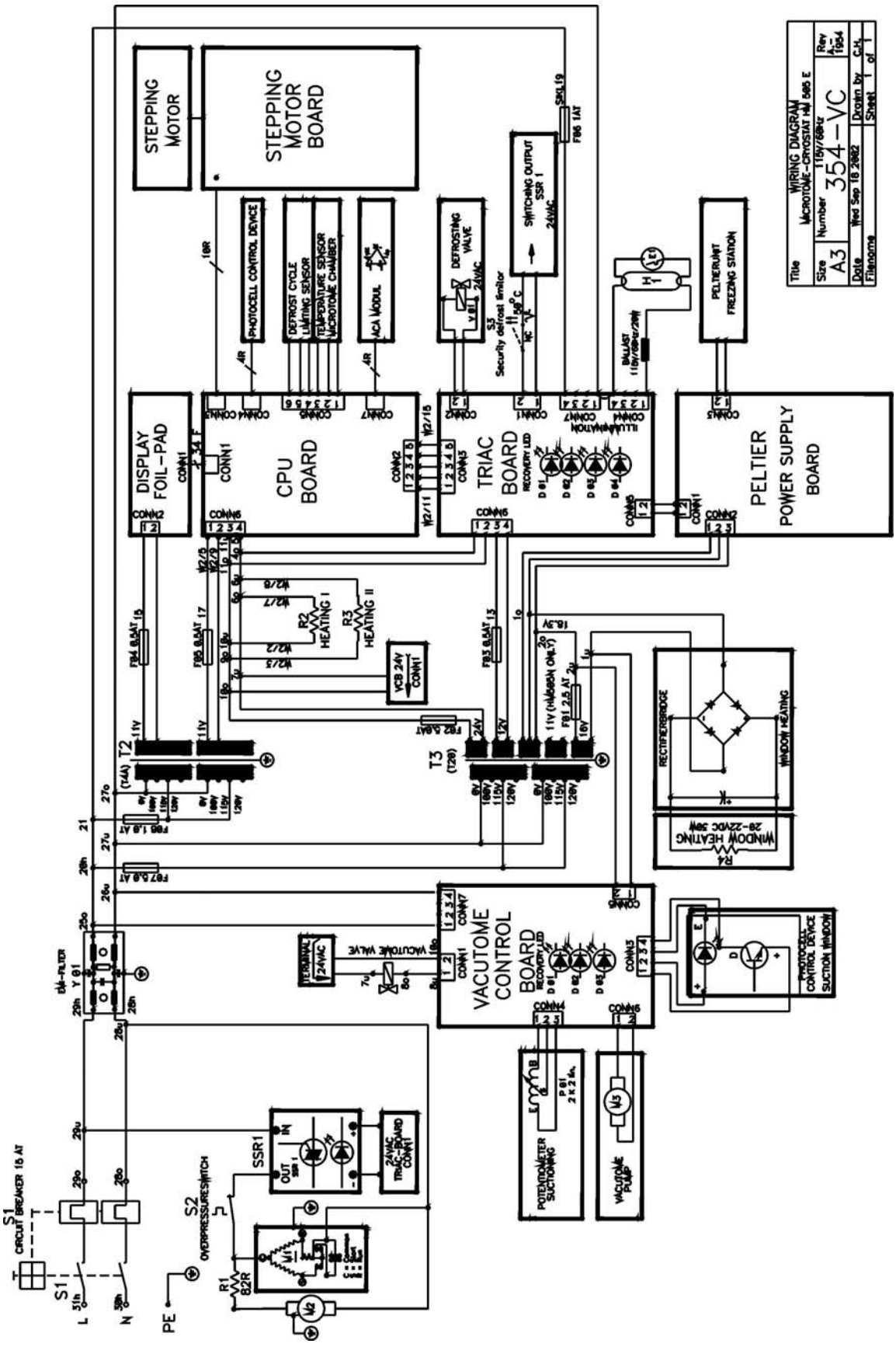

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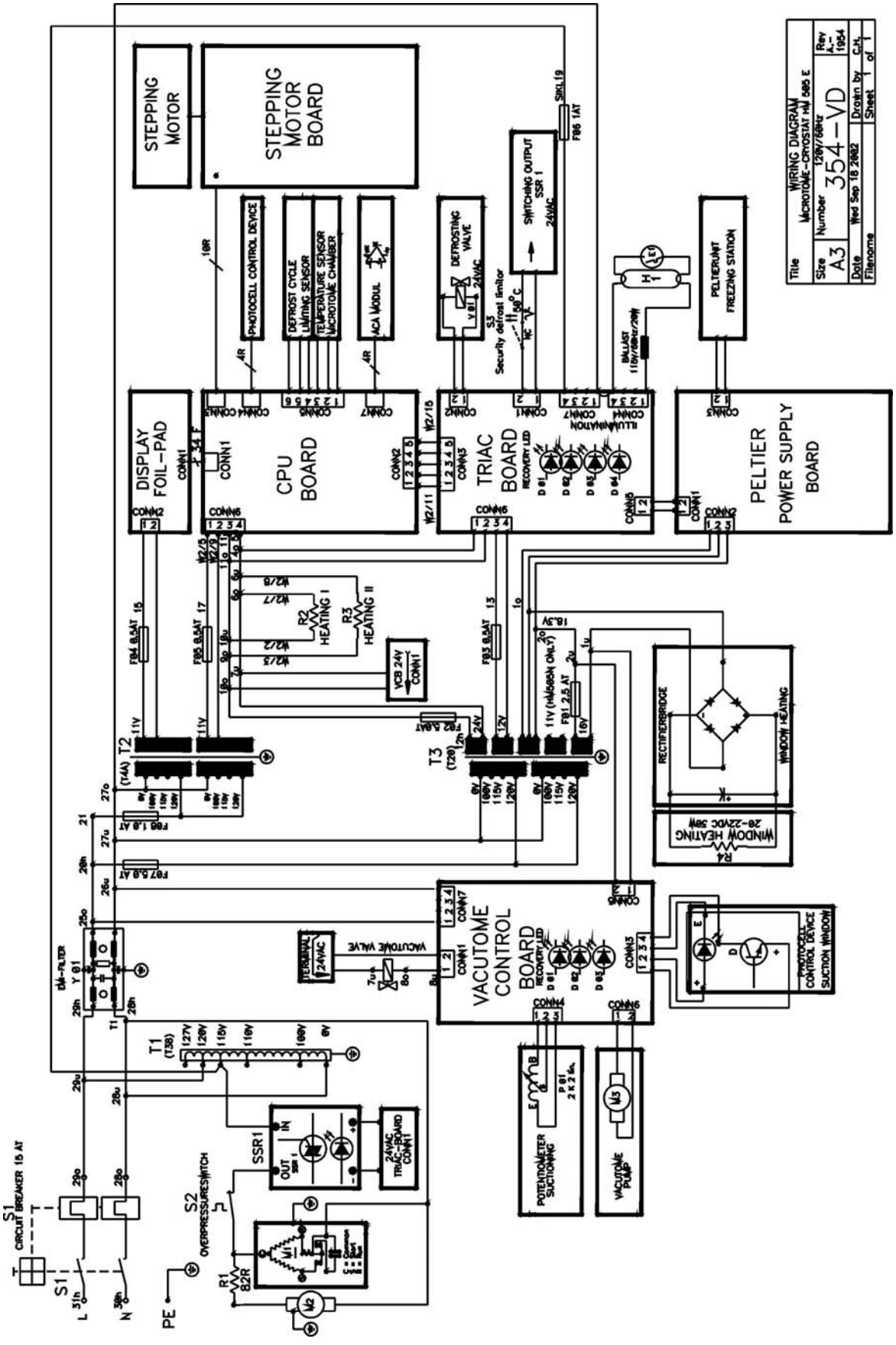

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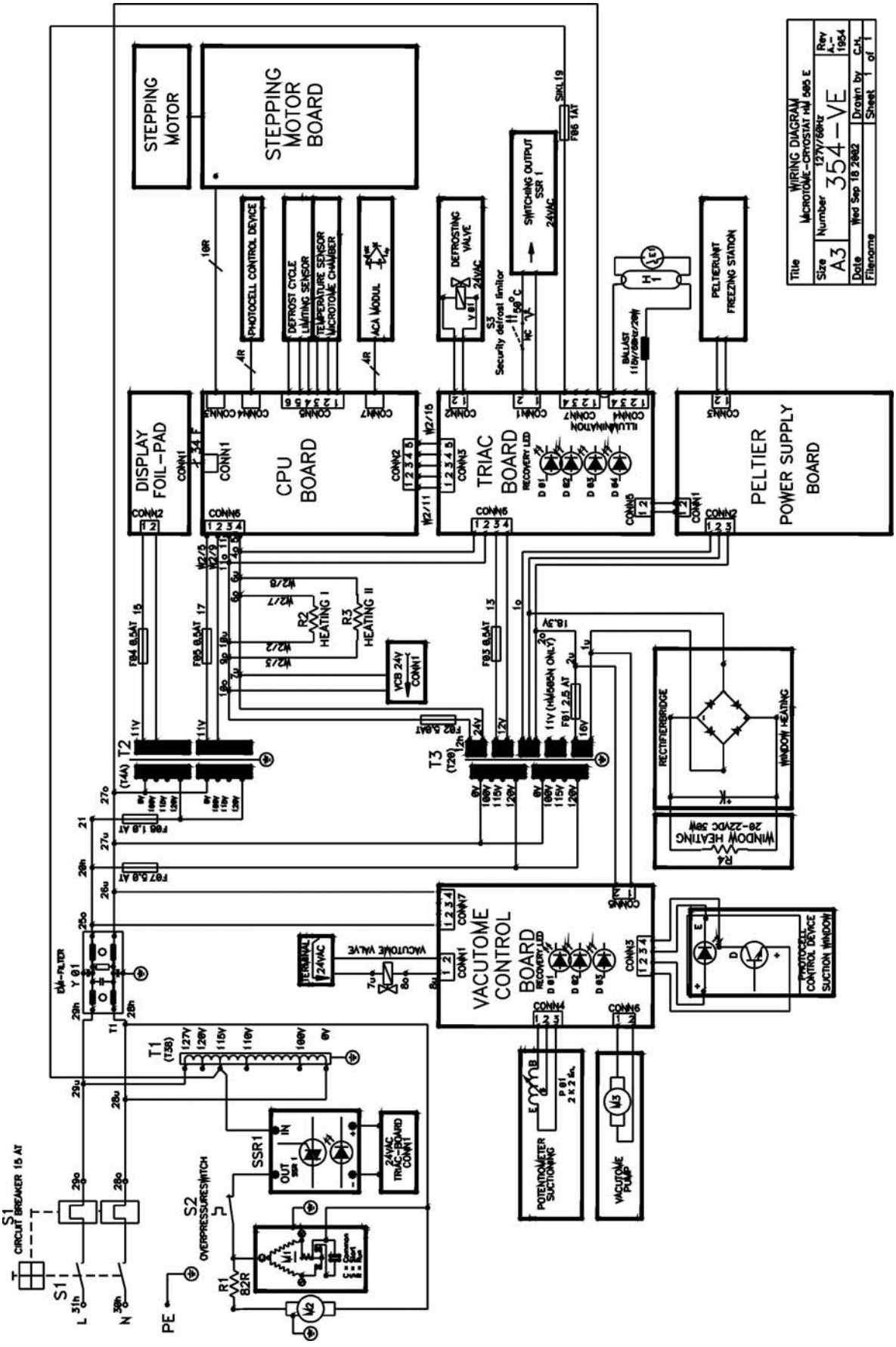

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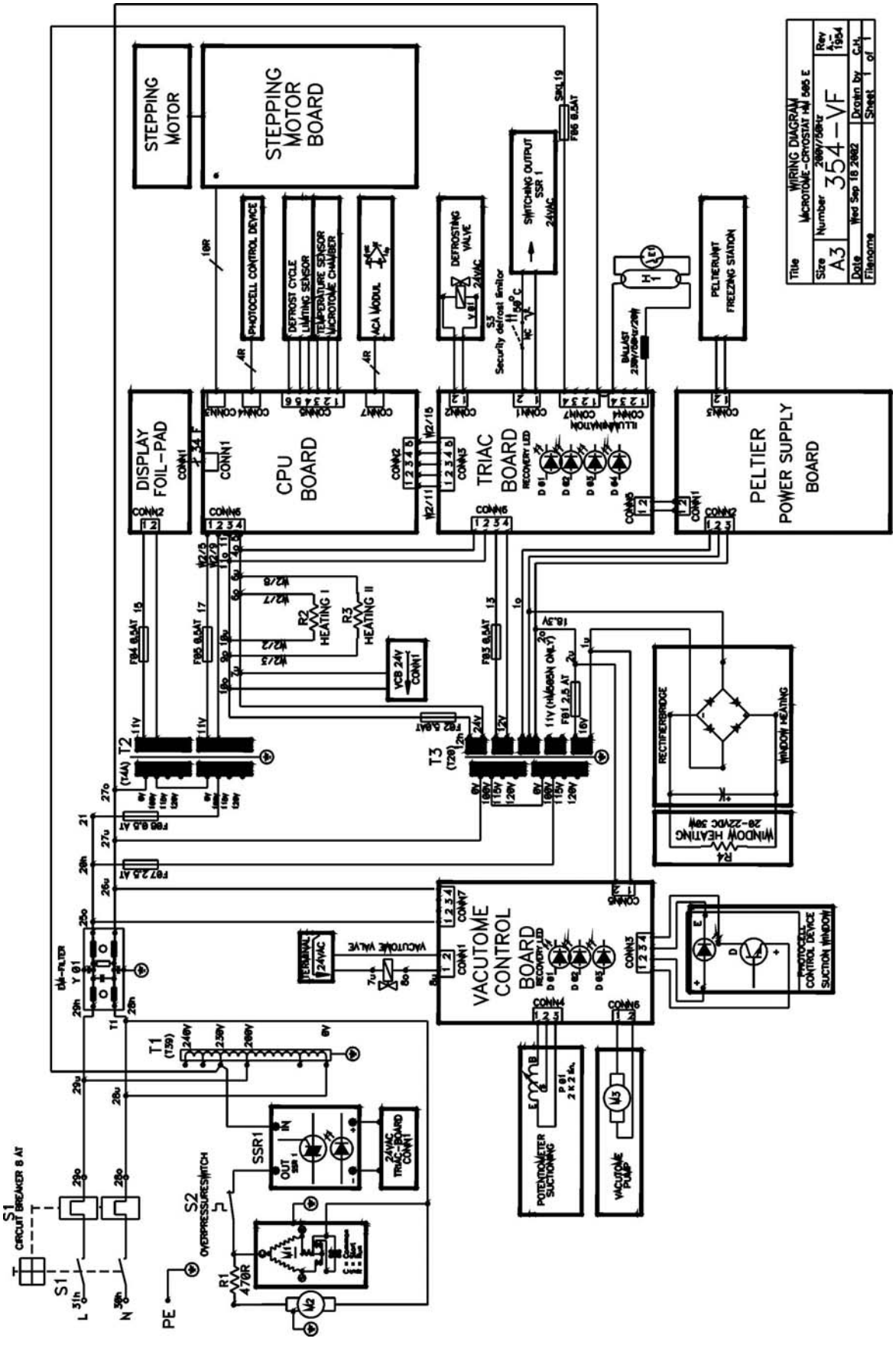

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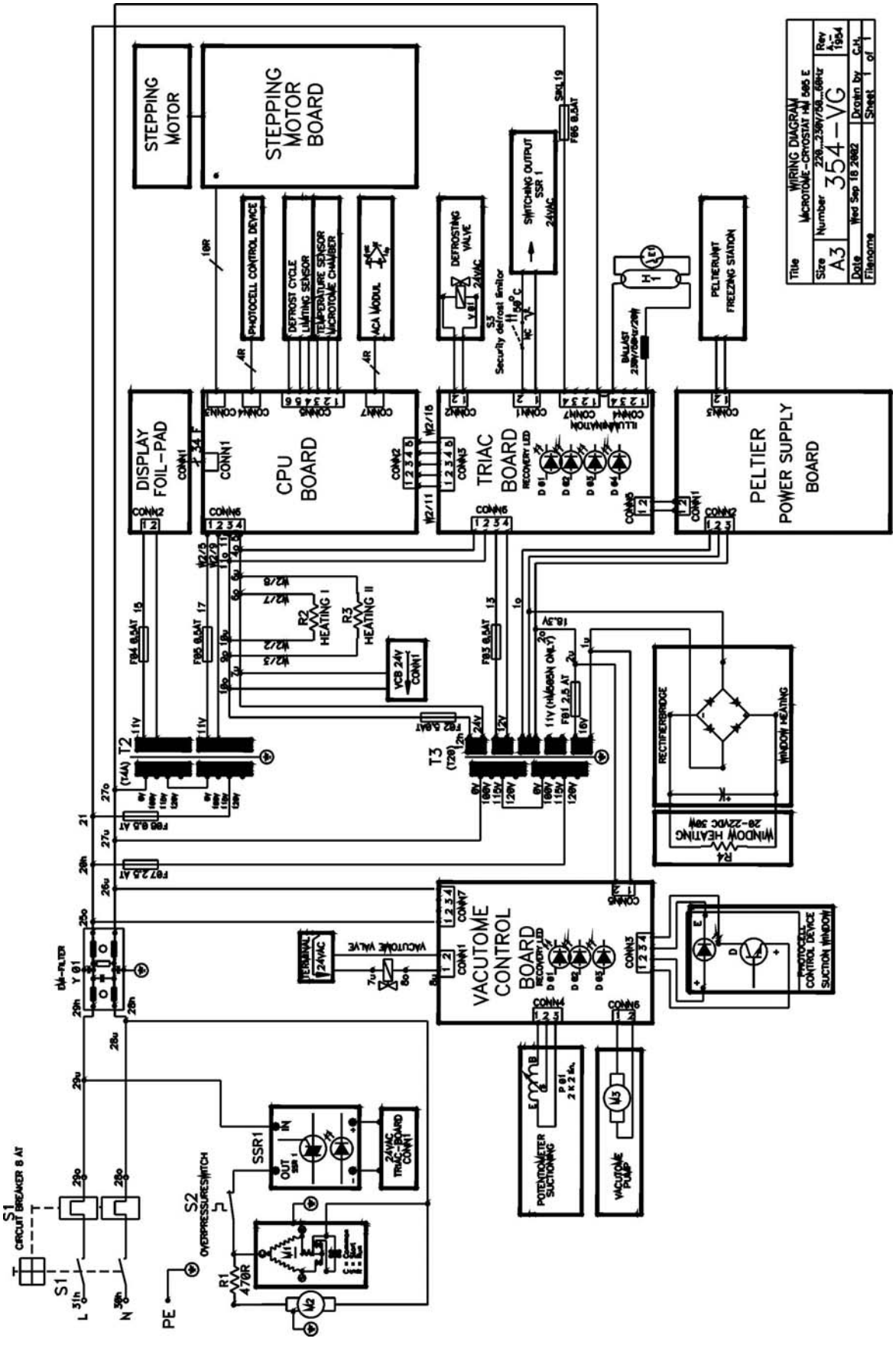

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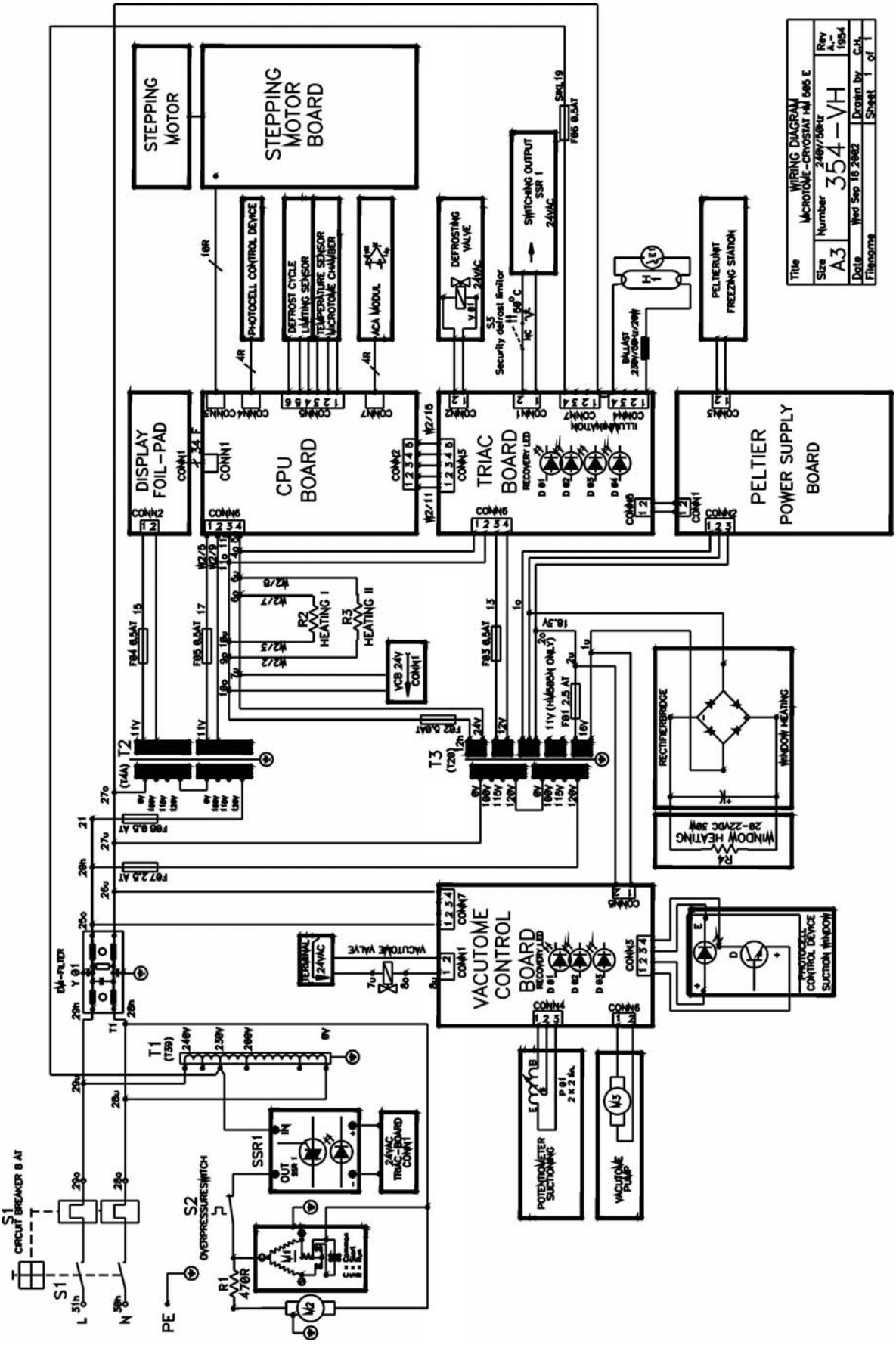

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4-3-3 Functional description of light barriers

The opto sensor board (fig. 21.2) is connected to CONN 4 of the CPU board. When activating the light barriers, information on the upper, lower and rear end position of the horizontal cylinder are transmitted to the CPU board via the plug connection (fig. 15.2) and the multi-function cable.
When the monobloc (fig. 7.8) moves vertically, the sensor plate (fig. 7.3), which is mounted to the distance sleeve (fig. 7.9), switches the light barrier (fig. 7.1) for the detection of the upper reversal point and the light barrier (fig. 7.4) for the detection of the lower reversal point. For the horizontal movement control, a sensor plate (fig. 7.5) is placed on the horizontal cylinder. Whenever the instrument is turned on, it is initialised and the horizontal position of the instrument is calibrated. For this, the stepping motor is triggered until the sensor plate (fig. 7.5) on the horizontal cylinder reaches the switching point of the light barrier (fig. 7.2) (calibration position). The rear end position of the horizontal feed range of the horizontal cylinder (28 mm) is not identical with the calibration position. The rear end position is defined and situated 1,28 mm before it.
For this reason, immediately after having reached the calibration position, the stepping motor moves the horizontal cylinder 1,28 mm forwards to be placed in the rear end position of the horizontal feed range.
Then, the number 28 000 is shown in the menu "remaining travel" on the display of the control panel. The front end position is determined by the processor on the CPU board considering the respective forward and backward movements. The horizontal cylinder moves into its calibration position only when the instrument is turned on. There is a malfunction, when the actual travel of the horizontal cylinder is not identical with the value calculated by the processor and the remaining value shown on the display as "remaining travel". For safety reasons, the front end position (remaining travel = 0) is approx. 1 mm before the mechanical stop.
A guidance (fig. 7.6) guarantees the correct horizontal guiding of the sensor plate for the exact detection of the calibration position, independently from the vertical position of the horizontal cylinder.

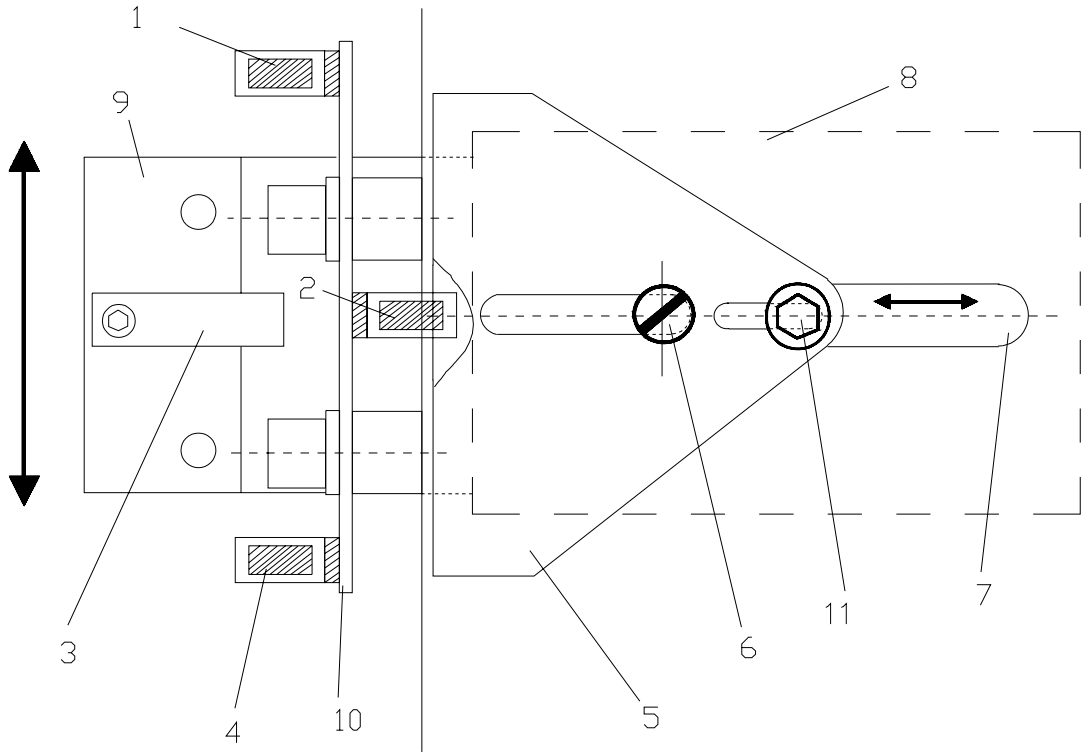


Fig. 7

1 = Upper light barrier
2 = Light barrier horizontal limit
3 = Sensor plate
4 = Lower light barrier
5 = Sensor plate
6 = Guidance sensor plate
7 = Opening cylinder with guidance
8 = Cylinder with guidance
9 = Distance sleeve
10 = Opto sensor board
11 = Fastening sensor plate

4-3-4 Functions of the CPU board

The enclosed block diagram shows the design of the control for the Cryostat HM 505 E.

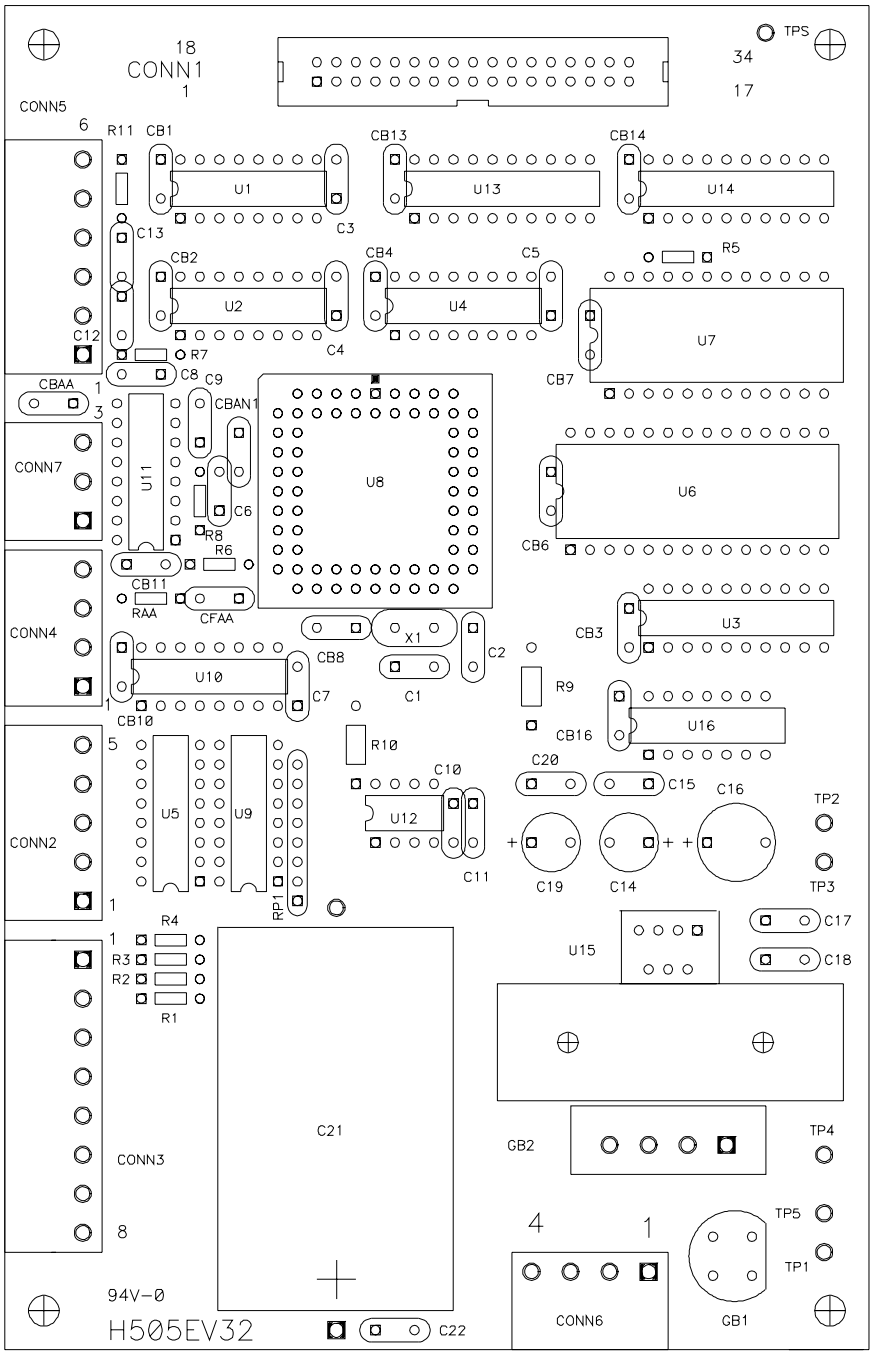
The processor is placed on the CPU board (fig. 18.11). This board is connected to the control panel board (fig. 18.7) via a 34-lead flat cable. Inputs from the keyboard are read by the CPU board, while the values to be indicated are transmitted to the displays. The CPU board gets further inputs from the defrost cycle limiting sensor, from the temperature sensor for the cooling chamber and from the opto sensor board as well as from the amplifier board (fig. 25.6) of the automatic approach system.

In the opposite direction, the CPU board sends control signals to the various receiving units in the cryostat, i.e. the stepping motor power control board (fig. 18.12) and the triac board (fig. 6a.24).
The CPU board (fig. 18.11) is connected with the triac board (fig. 6a.24) via a 5-lead wired connection, which is part of the 25-lead cable. On the triac board the control signals from the CPU board are converted and the solid state relais for the illumination of the cooling chamber, the cooling valve, the defrosting valve and the Peltier supply unit are triggered.

The CPU board supplies the power board (fig. 18.12) with a voltage of 27,2 VDC - 35 VDC (CONN 3, pin 7 and pin 8). The control signals for the stepping motor are also transmitted to the stepping motor power control board (fig 18.12) via CONN 3. The stepping motor power control board converts the control signals accordingly and triggers the windings of the stepping motor.

The light barrier unit (fig. 21.2) transmits three signals to the CPU board. On the one hand, the calibration position of the cylinder is detected when turning on the light barrier (fig. 7.2). On the other hand, the upper and lower reversal points of the vertical cutting movement are recognized by an upper (fig. 7.1) and a lower (fig. 7.4) light barrier each and transmitted to the CPU board. For this, a sensor plate (fig. 7.5) enters by turns the upper and lower forks of the light barriers.

Via the power cord the supply voltage is connected to the two main fuses. The outputs of the fuses are then connected to the main terminal.
The compressor and parallel the fan for the condenser are supplied from the power input via the power contactor (fig. 6a.38). The power contactor is switched via the mains switch.
The primary sides of the transformers are supplied by the mains fuses F1 and F2, the line filter and the mains switch. Between the mains switch and each transformer, one more fuse is installed. Fuse F3 protects transformer T20 (fig. 6a.6) and fuse F5 protects the transformer T4A (fig. 6a.41).
Transformer T20 supplies the window heating (16 V) (fig. 1.3), the heating arm rest (24 V), the triac board (12 V and 24 V) and the Peltier supply unit (2,3 V and 8 V). Transformer T20 (fig. 6a.6) also supplies the CPU board with 24 V.
Transformer T4A supplies the CPU board and the keyboard with display with 11 V each.



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CPU versions

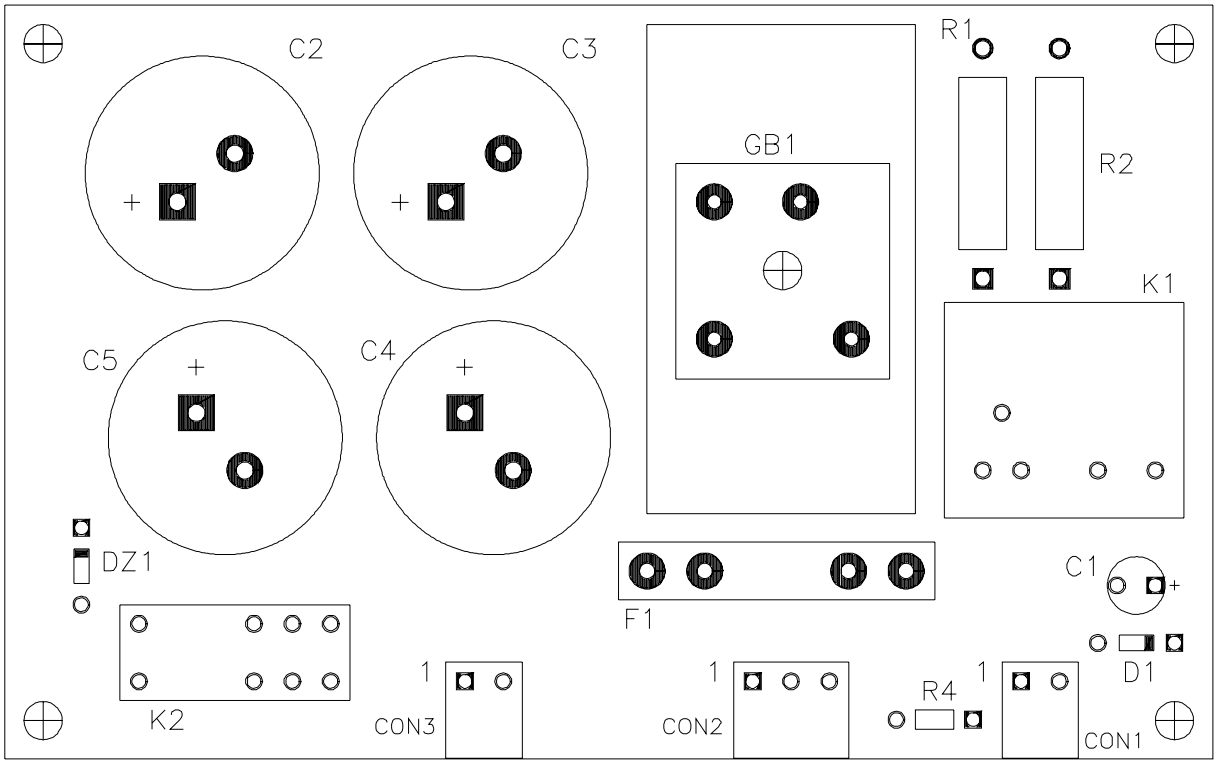
Cat. no. 604160	CPU version 2.2	505 E
Cat. no. 604180	CPU version 2.4	505 E
Cat. no. 604190	CPU version 2.4 P	505 EP

CPU version 2.2	cat. no. 604160	up to ser.no. 17667
CPU version 2.4	cat. no. 604180	from ser. no. up 17668

4-3-5 Functions of the Peltier supply unit

The transformer T20 supplies the Peltier supply unit (fig. 7.21) with two voltages (2,3 V and 8 VAC). These voltages are rectified on the Peltier supply unit board.
When the Peltier cooling station is turned on via the keyboard, the CPU board sends a signal to the triac board. A control signal of 24 VAC is transmitted to the Peltier supply unit (CONN 1) via the triac board (CONN 5). This is shown on the triac board, the diagnostic LED D4 lights.
If the Peltier element is turned on, a voltage of 5,0 to 7,0 VDC is applied on CONN 3 of the Peltier supply unit or on the Peltier element which is now cooling. If it is turned off, a voltage of -0,7 VDC to -1,5 VDC is applied on CONN 3 or on the Peltier element. This way, the Peltier cooling station is slightly warmed up, avoiding the formation of ice on the Peltier cooling station.
The Peltier element can only be turned on when the chamber temperature is below -10°C.

NOTE!
The deep freezing device can only be activated if the temperature of the cooling chamber is below -10°C.



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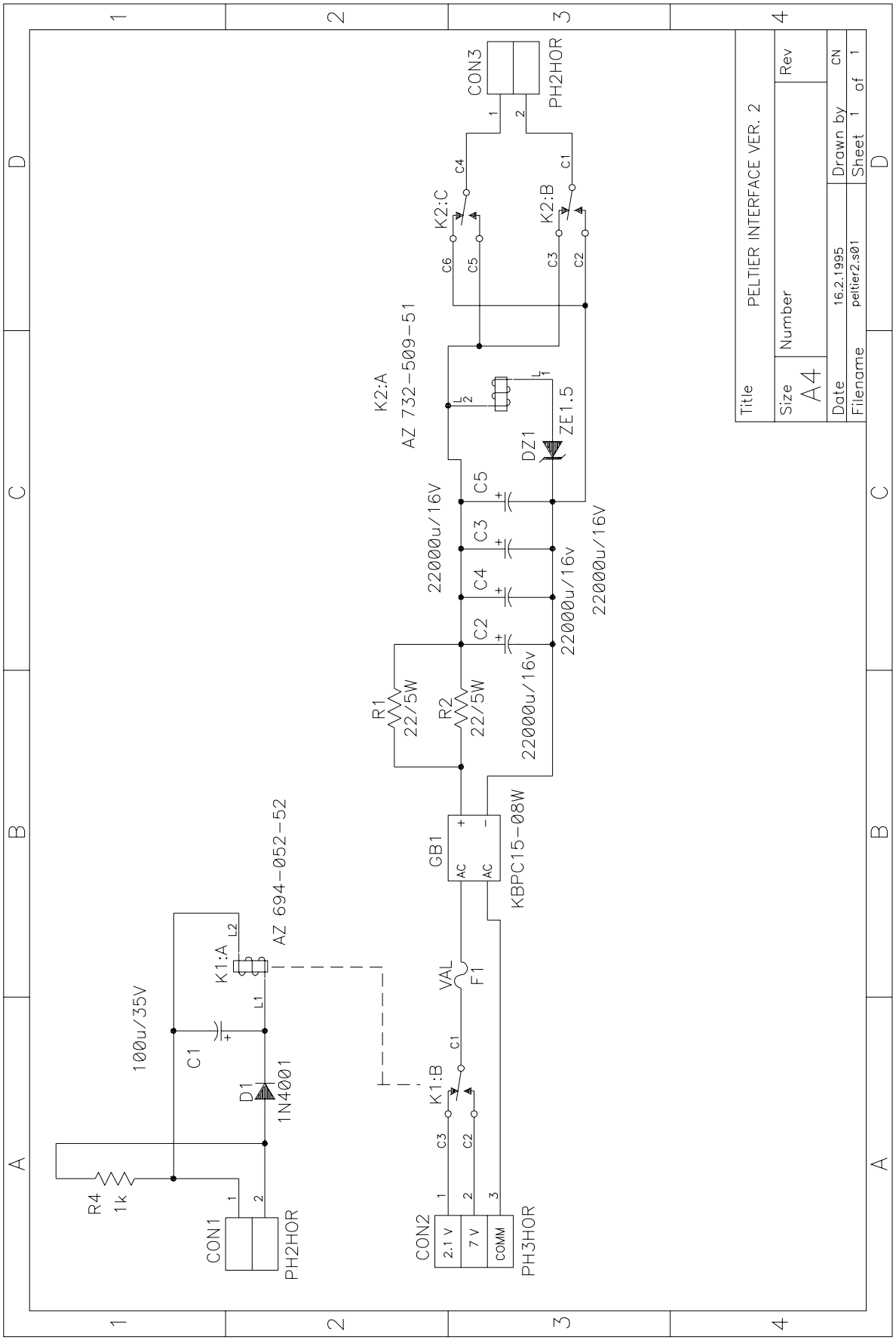

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4-4 Cooling system and defrosting

The chamber of the cryostat is cooled by a refrigeration machine. In the rear upper area of the cooling chamber is the evaporator which the cold refrigerant flows through. Due to the heat extraction from the cooling chamber a cooling down to -35°C can be achieved. On the left side of the cooling chamber there are freezing stations (fig. 14.12) to quickly freeze-on specimens onto specimen chucks. The temperature of the freezing stations is around -40°C.

Use the optional heat extractor (optional accessory, cat. no. 524500) to accelerate the freezing of the specimen. The temperature of the cooling chamber can be adjusted continuously down to -35°C. For this, pre-select the desired temperature as set value on the control panel. The actual value of the cooling chamber is constantly measured and sent to the control unit which causes the control valve to open and close.

When working on the microtome the dry cold air of the cooling chamber inevitably mixes with the warm humid ambient air. Frost forms on the finned evaporator. The increasing thickness of the frost reduces the efficiency of the evaporator. For this reason, the daily defrosting of the evaporator becomes necessary.

To carry out the defrosting process, let hot refrigerant gas flow through a bypass into the evaporator. The time of the daily defrosting process is set via the buttons DEFR TIME (fig. 12.14) as well as the buttons UP (fig. 12.17) and DOWN (fig. 12.16) on the control panel (fig. 12). This defrosting process is temperature controlled and varies according to the thickness of the frost.
In case the defrost time is exceeded due to a technical failure and/or the temperature in the evaporator reaches +50°C, the compressor is turned off via a safety sensor (fig. 8.21).
During the defrosting process, frost builds up on microtome and knife carrier. Normally, the frost recedes 2 - 3 h after the defrosting phase. To avoid condensation, the sliding window (fig. 8.11) is heated.

Figure 8 shows a schematic cross section of the cooling chamber with a flow chart of the cooling circulation of the cooling chamber.
The refrigerant gas is pressed through the nonreturn valve (fig. 8.9) into the condenser (fig. 8.2) via the compressor (fig. 8.1). The fan (fig. 8.12) cools the condenser (fig. 8.2) with air at ambient temperature. This leads to the condensation of the refrigerant, which then adjusts itself to a temperature of some degrees above ambient temperature.

After having been liquefied, the refrigerant flows through the tubings in the upper chamber area thus warming up this area. This way, condensation can be avoided. Afterwards the refrigerant flows through the filter dryer (fig. 8.8) and the capillary (fig. 8.3). For enhanced efficiency, the capillary is directed through the suction line to the compressor. On the capillary end the refrigerant expands and evaporates. This way, the desired cooling power in the fast freezing station (fig. 8.19), the drip pan (fig. 8.4), the drip water plate (fig. 8.5) as well as mainly in the evaporator (fig. 8.6) is generated. At the outlet of the evaporator to the suction tubing the refrigerant has been completely evaporated and exists now as a gas flowing through the suction line, which leads into the suction side of the compressor (fig. 8.1). Afterwards, the gas is condensed and the cooling process is started again.

For the protection against an excessively high pressure, e.g. due to fan failure, the compressor is equipped with a high pressure switch (fig. 8.18) on the pressure side of the compressor. This pressure switch is for manual reset after activation. It is activated at a pressure of 28 bar and then turns off the compressor. As the high pressure switch does not turn on automatically, the service organisation must be called for the reset of the switch. This way, an analysis of the cause of the failure is assured.

The defrosting of the evaporator (fig. 8.6) is activated by hot gas when the bypass valve (fig. 8.10) is opened. Then, while the compressor (fig. 8.1) is on, hot refrigerant gas is transmitted via the bypass line directly into the tubings of the drip pan, the drip water plate and the evaporator (fig. 8.6).

The bypass line is partly placed within the suction line (fig. 8.7) to guarantee that possible liquid coolant rests heat up and evaporate in the suction line before reaching the compressor.

The evaporator warms up and the frost melts. The drip water falls onto the drip water plate and is then directed into the drip pan. The water flows through the drain in the left rear part of the cooling chamber through a hose (fig. 8.13) into the collecting pan (fig. 8.14). This pan is heated by a copper tubing from the high pressure side of the compressor.

The temperature of the cooling chamber is measured by a temperature sensor (fig. 8.15) and transmitted to the CPU board.
The temperature of the cooling chamber is controlled by comparing the measured actual value with the set value, which was set via the control panel, and the resulting cyclic turning on/off of the compressor.

Defrosting is carried out automatically once in 24 hours. Immediate defrosting can also be selected. When defrosting, the bypass valve (fig. 8.10) is opened. During this process and also during the cooling phase, the compressor (fig. 8.1) is permanently on. At the same time, the warming up of the evaporator (fig. 8.6) is measured via the defrost cycle limiting sensor (fig. 8.16). It is inserted between the fins of the evaporator. This value is evaluated internally by the electronic and shown on the display. When the internally measured temperature is +6°C, the defrosting process will be stopped. The defrosting process will take approx. 8 - 12 min. for normal frost built-up. Afterwards, a new cooling phase starts. The defrosting time is limited to max. 20 min.

When starting the instrument, high surge currents (up to 20 A) flow. Exact power requirements with not more or less than +/-10% divergence must be used, especially when starting the instrument.

To comply with the power requirements in different countries, two types of compressors are used.

The filling amount of the refrigerant R 404 a is 0,490 kg.

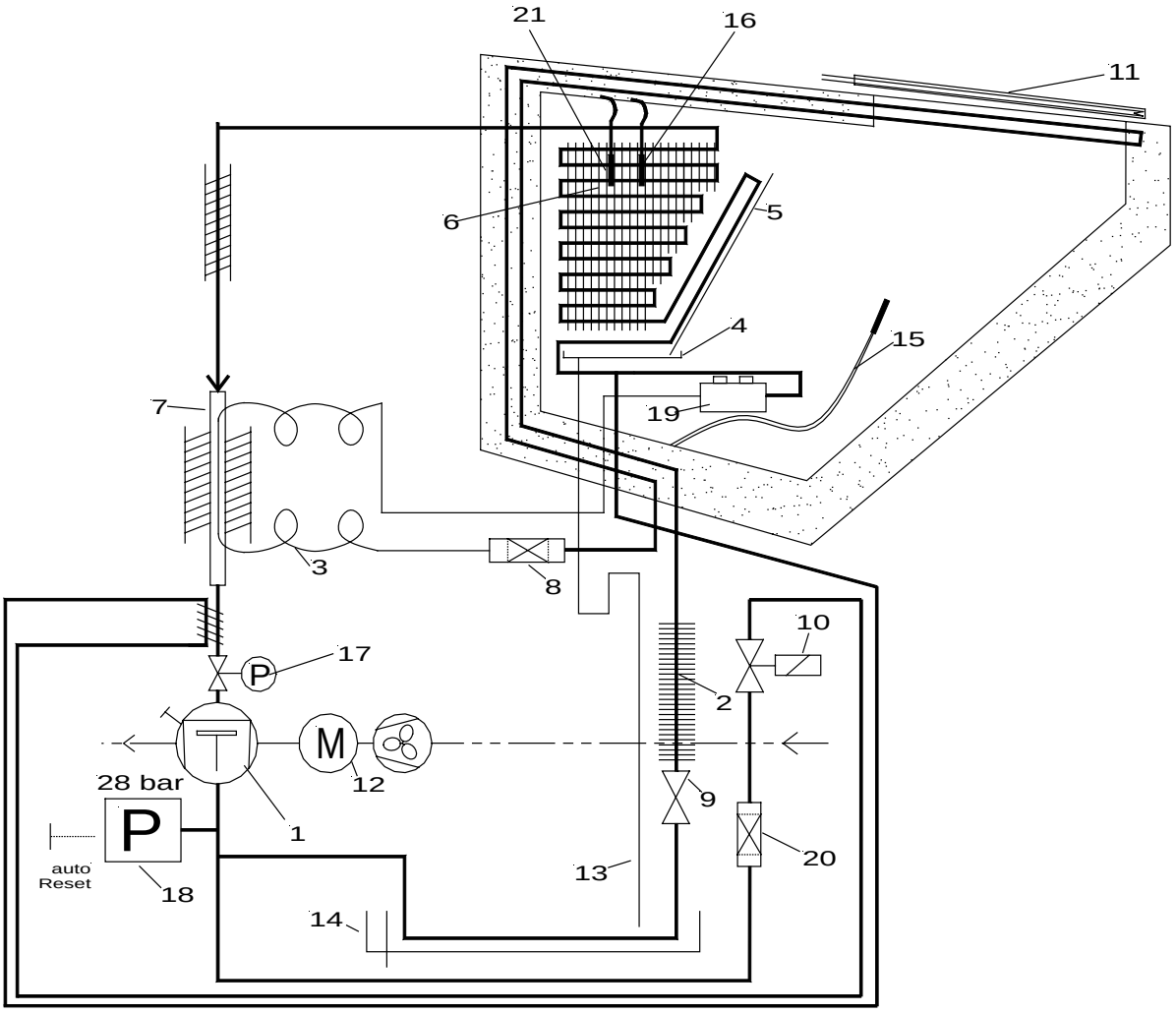

21
16
11
6
5
4
15
19
7
3
8
10
17
P
2
M
12
28 bar
P
1
9
20
auto
Reset
18
13
14

Fig. 8

Decription for fig. 8

1 = Compressor, Danfoss SC 18 G/SC15G
2 = Condenser
3 = Capillary tube
4 = Drip pan
5 = Drip water plate
6 = Evaporator, compl.
7 = Suction tube
8 = Filter dryer
9 = Nonreturn valve
10 = Bypass valve
11 = Heated sliding window
12 = Ventilation motor
13 = Collecting pan
14 = Condensation tray
15 = Temperature sensor, cryo chamber
16 = Temperature sensor, evaporator
17 = Starting controller
18 = High pressure switch
19 = Freezing station
20 = Filter
21 = Safety defrosting sensor (SSR-1) (314770)

From ser. no. 4914 up to ser. no. 9432 endurance run

Nominal voltage	**step up/down transformer primary - secondary**	**voltage on the compressor**	**type Danfoss**
230 V/50 Hz	---	230 V/50 Hz	SC18G
240 V/50 Hz	240 V/50 Hz - 230 V/50 Hz	230 V/50 Hz	SC18G
100 V/50 Hz	100 V/50 Hz - 230 V/50 Hz	230 V/50 Hz	SC18G
115 V/60 Hz	---	115 V/60 Hz	SC15G
100 V/60 Hz	100 V/60 Hz - 120 V/60 Hz	120 V/60 Hz	SC15G

From ser. no. 9433 up to ser. no. 13723 endurance run

Nominal voltage	**step up/down transformer primary - secondary**	**voltage on the compressor**	**type Aspera**
100 V/50 Hz	---	100 V/50 Hz	T2168GKCSR
100 V/60 Hz	100 V/60 Hz - 120 V/60 Hz	100 V/60 Hz	T2168GKCSR
115 V/60 Hz	---	115 V/60 Hz	T2168GKCSR
220 V/60 Hz	---	220 V/60 Hz	T2168GKCSIR
230 V/50 Hz	---	230 V/50 Hz	T2168GKCSIR
240 V/50 Hz	240 V/50 Hz - 230 V/50 Hz	240 V/50 Hz	T2168GKCSIR

From ser. no. 13723 up to ser. no. 17667 endurance run

Nominal voltage	**step up/down transformer primary - secondary**	**voltage on the compressor**	**type Danfoss**
230 V/50 Hz	---	230 V/50 Hz	SC18G
240 V/50 Hz	240 V/50 Hz - 230 V/50 Hz	230 V/50 Hz	SC18G
100 V/50 Hz	100 V/50 Hz - 230 V/50 Hz	230 V/50 Hz	SC18G
115 V/60 Hz	---	115 V/60 Hz	SC15G
100 V/60 Hz	100 V/60 Hz - 120 V/60 Hz	120 V/60 Hz	SC15G

From ser. no. 17668 on ON/OFF

Nominal voltage	**step up/down transformer primary - secondary**	**voltage on the compressor**	**type Danfoss**
230 V/50 Hz	---	230 V/50 Hz	SC18G
240 V/50 Hz	240 V/50 Hz - 230 V/50 Hz	230 V/50 Hz	SC18G
100 V/50 Hz	100 V/50 Hz - 230 V/50 Hz	230 V/50 Hz	SC18G
115 V/60 Hz	---	115 V/60 Hz	SC15G
100 V/60 Hz	100 V/60 Hz - 120 V/60 Hz	120 V/60 Hz	SC15G

Part 5 Maintenance methodology

5-1 Maintenance levels

Level I: User maintenance

Installation
Turning-on
Cleaning
Installing accessories

Level II: Service technician maintenance

Routine maintenance
Installing accessories
Diagnostics
Replacement of assemblies and parts
Executing service contracts

Level III: Factory maintenance

Repair of assemblies and parts
Repair of major damage

Work listed in the maintenance level I can be carried out by the operator himself and is listed in the instruction manual.

Work listed in level III is carried out in the factory. For this, it is necessary to return the cryostat microtome in its original packing.

NOTE! Maintenance levels II and III may only be performed by trained service technicians. Unautorized modification or repair by third party persons will void the warranty.

5-2 Field maintenance techniques

Service and maintenance work listed in level II are carried out by a trained service technician.

A routine maintenance should be performed once a year:

5-2-1 Work on the microtome

Check the movable parts for good surface quality, dimensional accuracy and wear and tear.

Check the cross roller bearings (vertical and horizontal) for noise as well as the various torques.

Check the feed and retraction behaviour of the stepping motor via a dial gauge (see part 5-2-2, checking the feed by means of a dial gauge).

Check motor drive, brake of the handwheel, belt tension and adjust, if necessary. Check the smoothness as well as the impact of the handwheel and adjust, if necessary.

Lubricate all movable parts, cross roller bearings with oil (cat. no. 350040) and link block with grease (cat. no. 350140).

The service technician will attempt to determine which assemblies and parts lead to the malfunctions and replaces them with good ones.

The defective assemblies and parts should then be returned to the factory for repair or replacement.

5-2-2 Checking the feed by means of a dial gauge

Remove the microtome housing, place the dial gauge holder on the thread (fig. 19.3) via the screw. The pin of the dial gauge must touch the front side of the cylinder. Set the feed value on the control panel. Then compare this value with the feed carried out by the stepping motor. The correct retraction value must be 40 µm.

To check the microtome outside the cryostat, we offer a checking line (elongation line) of 2,5 m available under cat. no. 614150.

To check the automatic approach system also outside the cryostat, we offer a checking line of 2,5 m available under cat. no. 614170.

Part 6 Assembly and spare parts list

The below listed assemblies and parts may only be replaced by trained service technicians. Detailed descriptions of the replacement work can be found in part 8 and 9 of this service manual.
Positions, which are marked with *, are just included in this list for detailed description. However, they do not represent a service part.

Fig. no.	Description	Cat. no.
1.1	Housing	463000
1.2	Touchpad keyboard	610210
1.3	Heated sliding window	626130
1.4	Grip f. sliding window	424450
1.5	Lever	432630
1.6	Handwheel	444510
1.7	Handle	424100
1.8	Opening for adjusting screws	*
1.9	Rubber mat	261210
2.1	Front panel	410140
2.2	Side panel, left	410170
2.3	Main frame	*
2.4	Rear panel	410340
2.5	Right side panel	410160
2.6	Touchpad keyboard	610210
2.7	Foot	440180
2.8	Fastening side panel	*
2.9	Fastening roller	*
2.10	Fixed roller	444560
2.11	Condenser	620070
2.12	Drive support	524170
2.13	Fastening side panel	*
2.14	Fastening side panel	*
2.15	Fastening safety ground	*
2.16	Fastening safety ground	*
2.17	Handwheel	444510
2.18	Handle	424100
2.19	Fastening handwheel M8x25	*
2.20	Cover disk	402070
2.21	Fastening side panel	*
2.22	Foamed material	*
2.23	Foamed material	*
2.24	Holding support	460350
2.25	Rubber mat	261210
2.26	Cover cap	*
2.27	Nut	*
3.1	Frame	422070
3.2	Base plate	528110
3.3	Thrust piece	*
3.4	Adjusting screw	*
3.5	Threaded pin	*
3.6	Star handle	261160
3.7	Lever	432450

Fig. no.	Description	cat. no.
3.8	Handle	424500
3.9	Clamping ledge	440670
3.10	Shaft with bearing (incl. 3.11)	550050
3.11	Shaft with bearing (incl. 3.10)	550050
3.12	Cross roller bearings	518330
3.13	End pieces	*
3.14	Fastening cross roller bearings	*
3.15	Cylinder with guidance	518350
3.16	Cross roller bearings	518330
3.17	Cylinder head	556070
3.18	Ball piece	408850
3.19	Fastening housing	*
3.20	Fastening microtome	*
3.21	Shield	*
3.22	Fastening shield	*
4.1	Cylinder pin	*
4.2	Link block	421050
4.3	Cylinder with guidance	518350
4.4	Slide hook	420100
4.5	Crank arm	432290
4.6	Shaft	404280
5.1	Flexible coupling	436090
5.2	Bearing disc	449110
5.3, 5.4, 5.5	Spindle complete	554210
6a.1	Chassis	*
6a.2	Power cord (220 V - 240 V)	314320
	Power cord US plug (100 V - 115 V)	314340
6a.3	Control cable compressor	*
6a.4	Control cable high voltage	*
6a.5	Control cable low voltage	*
6a.6	Transformer T20	310650
6a.7	Ground connection (protective conductor)	*
6a.8	Transformer T 4a	310130
6a.10	Vacutome control unit (220 V – 240 V)	605030
	Vacutome control unit (100 – 115 V)	605020
6a.11	Relay	322930
6a.12	Line filter	335520
6a.20	Triac board	604170
6a.21	Peltier board	602040
6a.22	Terminal block	638290
6a.23	Transformer T 39 (only 240 V)	310940

Fig. no.	Description		Cat. no.
7.1	Upper light barrier		*
7.2	Light barrier horizontal limit		*
7.3	Sensor plate		410610
7.4	Light barrier		*
7.5	Sensor plate		410600
7.6	Guidance sensor plate		*
7.7	Hole cylinder with guidance		*
7.8	Cylinder with guidance		518350
7.9	Distance sleeve		409020
7.10	Opto sensor board		604600
7.11	Fastening sensor plate		*
8.1	Compressor (Danfoss)	(100 V - 115 V) SC15GX	622110
		(220 V - 240 V) SC18GX	622120
8.2	Condenser		620070
8.3	Capillary tubing		*
8.4	Drip pan		*
8.5	Drip water plate		*
8.6	Evaporator, complete		620210
8.7	Suction tube		*
8.8	Filter dryer		606050
8.9	Nonreturn valve		*
8.10	Bypass valve		342160
8.11	Heated sliding window		626130
8.12	Fan motor, 50 Hz, 7 watt	(100 V - 115 V)	320310
		(220 V - 240 V)	320200
8.13	Condensation hose		*
8.14	Collecting pan		408830
8.15	Temperature sensor f. cooling chamber		330320
8.16	Temperature sensor f. evaporator		330320
8.18	High pressure switch		342140
8.19	Freezing station		*
8.20	Filter		606060
8.21	Safety defrosting sensor		314770
9	Key f. micrometer nut		362090
9	Torque measurement device		358170
10.1	Threaded pin		*
10.2	Threaded pin		*
10.3	Hole		*
10.4	Adjusting bush		415040
10.5	Hole		*
10.6	Thrust piece		*
10.7	Base plate		528110
10.8	Clamping ledge		*
10.9	Clamping lever		432450
11.1	Head		408820
11.2	Ball piece		408850
11.3	Ball shell		408840
11.4	Ball shell		408840
11.5	Threaded ring		446120

Fig no.	Description	Cat. no.
11.6	Threaded bush	414460
11.7	Locking screw M4x8	*
11.8	Screw M5x10	*
11.9	Lever	432450
11.10	Handle	424370
11.11	Star handle	261160
11.12	Threaded pin	*
12	Touchpad keyboard	610210
13.1	Allen screw M6x30	*
13.2	Base plate	528110
13.3	Oldham clutch	550070
13.4	Adjusting stop	532050
14.1	Housing	463220
14.2	Frame	422070
14.3	Right shelf	410530
14.4	Left shelf	410630
14.5	Shield	402470
14.6	Fastening temperature sensor	430510
14.7	Cylinder head	556070
14.8	Clamping lever	432450
14.9	Brush shelf	502110
14.10	Section waste tray	502160
14.11	Base plate	528110
14.12	Cooling stations	414410
15.1	Connector socket f. automatic approach system	*
15.2	Connector socket f. stepping motor	*
15.3	Housing f. PC board	520650
15.4	PC board	604600
15.5	Cable leadthrough	*
15.6	Cable leadthrough	*
15.7	Light barrier	*
15.8	Fastening	*
16.1	Drive support compl.	524170
16.2	Toothed wheel	*
16.3	Toothed wheel	466270
16.4	Clamping bolt	412690
16.5	Pressure spring	*
16.6	Pin	*
16.7	Connecting rod	458050
16.8	Bolt	458040
16.9	Adjusting screw	*
16.10	Lever	432630
16.11	Allen screw M8x25	*
16.12	Cover disk	402070
16.13	Plain washer	*
16.14	Allen screw	*
16.15	Toothed belt	260050

Fig. no.	Description	Cat. no.
16.16	Handwheel	444510
16.17	Locking hole	*
	Brake, complete	534120
17.1	Delrin washer	*
17.2	Fillister head screw M4x12	*
17.3	Oldham clutch	550070
17.4	Torque washer	*
17.5	Shaft	404830
17.6	Groove	*
17.7	Feather key	*
17.8	Fillister head screw	*
17.9	Plain washer	*
17.10	Cover disk, large	402200
17.11	Bush, large	414550
17.12	Wall of housing	*
17.13	Toothed wheel	466270
17.14	Groove nut	210090
18.1	Top cover	463000
18.2	Hinge	261220
18.3	Power switch	322220
18.4	Cable channel	*
18.5	Fastening safety ground conductor	*
18.6	LED display	*
18.7	Touchpad keyboard	610210
18.8	LED display	*
18.9	Fluorescent lamp	346050
18.10	Starter	322650
18.11	CPU board compl.	604180
18.12	Stepping motor power control board	604140
18.13	Fastening top cover	*
19.1	Horizontal cylinder	*
19.2	Amplifier with flange	642140
19.3	Fastening dial gauge holder	*
19.4	Fastening bar	*
19.5	Bar	430050
19.6	Slide hook	420100
19.7	Clamping segment	430060
19.8	Fillister head screw	*
19.9	Monobloc (cylinder with guidance)	518350
19.10	Counternut	449100
19.11	Spring	*
19.12	Pin	*
19.13 + 19.14	Micrometer nut with spindle	554210
19.15	End of micrometer spindle	*
19.16	Running disk	254130
19.17	Axial needle wheel	254110
19.18	Axial disk	254120
19.19	Bearing disk	449110
19.20	Countersunk screw M4x12	*

Fig. no.	Description	Cat. no.
19.21	Equalizing disk	448010
19.22	Threaded ring	446190
19.23	Fastening flexible coupling	*
19.24	Flexible coupling	436090
19.25	Distance sleeve	409020
19.26	Access flexible coupling fastening micrometer spindle	*
19.27	Access flexible coupling fastening stepping motor shaft	*
19.28	Fastening stepping motor	*
19.29	Clamping disk	*
19.30	Fillister head screw M4x30	*
20.1	Frame	422070
20.2	Base plate	528110
20.3	Fastening cover sheet	*
20.4	Cover sheet	464290
20.5	Fastening	*
20.6	Crank arm	432290
20.7	Fastening housing	*
20.8	Opto sensor board	604600
20.9	Bearing disk	449110
20.10	Flange	408300
20.11	Shaft	404280
20.12	Type plate	*
20.13	Fastening	*
20.14	Stepping motor	320130
20.15	Stepping motor	320130
20.16	Fastening	*
20.17	Sensor plate	410610
20.18	Upper light barrier	*
20.19	Lower light barrier	*
20.20	Hole f. cable	*
20.21	Distance sleeve	409020
20.22	Fastening bearing disk	*
20.23	Distance bolt M4x60	*
20.24	Strain relief	*
20.25	Connection cable stepping motor	*
20.26	Connection cable ACA	*
21.1	Housing f. PC board	520650
21.2	PC board	604600
21.3	Light barrier, lower reversal point	*
21.4	Light barrier, upper reversal point	*
21.5	Connector 1	*
21.6	Connector 3	*
21.7	IC component	*
21.8	Rubber sleeve	*
21.9	Rubber sleeve	*
21.10	Cover angle	464290
21.11	Distance bolt	*
21.12	Plain washer	*
21.13	Allen screw	*
22	Cylinder with guidance	518350

Fig. no.	Description	Cat. no.
23a.1	Link block	421050
23a.2	Crank arm	432290
23a.3	Delrin washer	*
23a.4	Ball bearing	254020
23a.5	Flange	408300
23a.6	Plain washer	*
23a.7	Fillister head screw	*
23a.8	Plain bearing bush	208030
23a.9	Shaft	404280
23b.1	Link block	421050
23b.2	Cylinder pin	*
23b.3	Crank arm	432290
23b.4	Flange	408300
23b.5	Plain washer	*
23b.6	Fillister head screw	*
23b.7	Delrin washer	*
23b.8	Oldham clutch	550070
23b.9	Fillister head screw M4x12	*
23b.10	Torque disk	*
24.1	Frame	422070
24.2	Cylinder with guidance	518350
24.3	Fastening cross roller bearings	*
24.4	Cross roller bearings, right	518330
24.5	Fastening cross roller bearings	*
24.6	Cross roller bearings, left	518330
24.7	Fastening end piece	*
24.8	End piece	*
24.9	Hole for adjusting screws	*
24.10	End piece	*
24.11	Fastening end piece	*
24.12	Roller cage	518360
25	Amplifier with flange for the automatic approach system	642140
26.1	Chassis	410620
26.2	Power cord	314320
	Power cord 100 –120 V	314340
26.3	Control cable	*
26.4	Control cable	*
26.5	Control cable	*
26.6	Transformer T20	310650
26.7	Compressor	
	Danfoss, SC15GX	622110
	Danfoss, SC18GX	622120
26.8	Transformer T4a	310130
26.9	Filter dryer	606060
26.10	Vacuum control	
	230 V	605030
	115 V	605020

Fig. no.	Description	Cat. no.
26.11	Relay	322930
26.12	Line filter	335450
26.13	Vacuum pump	
	230 V	320340
	115 V	320350
26.14	Pressure switch (autom. Reset)	342220
26.15	Paddle	334330
26.16	Fan motor	
	230 V	320200
	115 V	320310
26.17	Fastening stand	334290
26.18	Collecting pan	408830
26.19	Condenser	620070
26.20	Triac board	604170
26.21	Peltier board	602040
26.22	Terminal block	638290
26.23	Cable channel	*
26.25	Connection	*
26.26 + 27	Magnetic coil and valve (defrosting)	342160
27	Packing	354140

Necessary spare parts, which are not included in a figure.

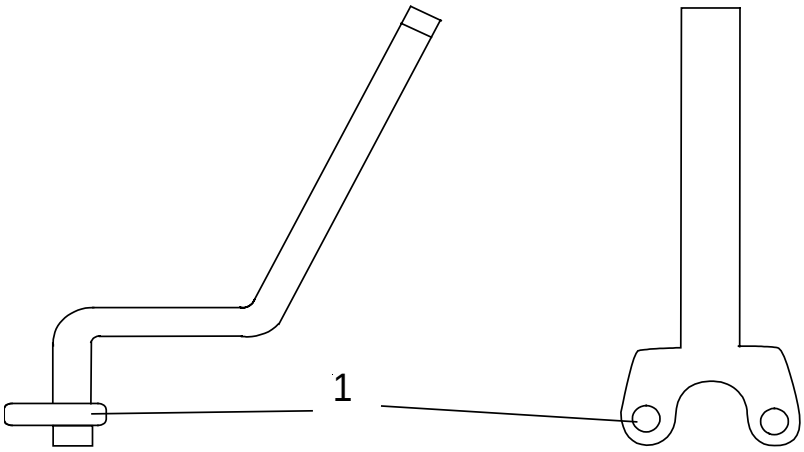
Cat. No.	Description
350230	Touch-up applicator, white, RAL 9010
350240	Touch-up applicator, grey, RAL 7038
350250	Touch-up applicator, black, RAL 9005
350010	Oil, 100 ml
350040	Cryostat oil, 100 ml
350140	ISO Flex grease
350190	Loctite no. 638, green, 10 ml
350200	Loctite no. 222e, pink, 10 ml
350210	Loctite no. 243, blue, 10 ml
402070	Cover disk for handwheel
614150	Checking line stepping motor 2,5 m
614170	Checking line automatic approach system 2,5 m
626070	Heating band for arm rest 24V/10 W

Part 7 Tools and equipment

To carry out repair or replacement work, the below-mentioned special tools as well as a set of standard tools are required.

Description	Cat. no.
Four-way socket wrench for threaded bush	362030
Torque wrench	362060
Dial gauge	362070
Dial gauge holder	648010
Spring scale for micrometer mechanism	362080
Key for micrometer spindle	362110
Set of Allen keys	362130
Set of fork wrenches	362150
Set of Allen keys with grip	362440
Adjustable face spanne size 2	362200
Key for micrometer nut	362090
Torque measurement device	358170
Hook key, size 30 - 32	362190
Bit insert, 2 mm	362290

key for micrometer nut cat. no.: 362090



torque measurement device for micrometer spindle Cat. no. 358170

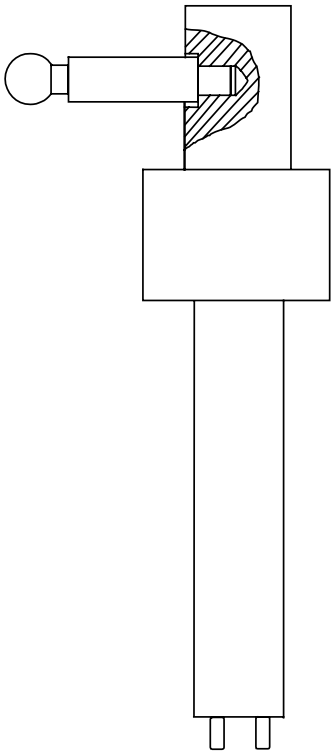


Fig. 9

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Part 8 Fault diagnostics

This part includes some general guidelines and hints on how to define a service problem and to replace the defective assembly or part.

8-1 General techniques

To determine malfunctions, good knowledge and understanding of the architecture of the cryostat is required. The trained service technician should have carefully read the instruction manual of the cryostat. After having studied part 4 of this service manual, the service technician should normally be able to define the defective part.

When there appears to be a problem with the instrument, the service technician should check a few things first:

Physical damage

Examine the instrument for deformation.

Proper installation

Check if the power requirements indicated on the type plate correspond to the power supply voltage being used.

The installation site must be chosen so that enough ventilation for the cooling system is guaranteed. The distance between wall and rear panel should be approx. 10 - 15 cm. Moreover, the suction areas on either side must be kept free.
Please avoid draught by open doors or by air conditioning systems at the installation site. In addition, the microtome chamber should not be exposed to sunlight.

Check cables and connections

Check for proper wire clamping and for proper connections at flat cable connectors and their lockings.

Try again

Despite the considerable power conditioning circuitry of the cryostat, occasionally major power source transients can cause temporary malfunctions. Turn the instrument off. After a few seconds, turn the instrument on and try again.

Contact the factory

During regular business hours (Central European Time), a service technician will always be available for telephone assistance.
Considerable time and expense may be saved by consulting the factory.

Phone: Germany 6227 / 836-0

8-2 Diagnostics

Error	Cause	Remedy	Ref.
Thick-thin sections	Sharpness of knife	Check, resharpen	
	Knife angle	Check, adjust	8-3
	Clampings on knife carrier	Check, adjust	8-4
	Clampings on specimen cylinder	Check, adjust	8-5
	Dirty cylinder	Clean and lubricate it	
	Micrometer play	Readjust micrometer nut	9-7
	Cross roller bearings	Check, clean, lubricate, adjust, 6 Ncm, replace, if necessary	8-6 9-9
Tight handwheel:			
partly	Debris and section waste between monobloc and base plate	Remove and clean	9-1 8-6
during the entire movement	Dirty link block	Clean	8-7
	Tension of toothed belt	Adjust	9-9
Vibrations when cutting:			
manual	Cross roller bearings	Check, adjust	9-10
	Link block	Replace	9-9
No feed,	Loose connectors	Check	
no retraction	Cable connection to the motor	Check	9-6 9-4-3
	Stepping motor power control board	Check	9-4-3
	CPU board	Check	9-6
	Loose flexible coupling	Tighten fastening screws	9-8
	Tight cylinder	Check, replace if necessary	9-8
	Seized guide wedges	Check, smooth, lubricate	
	Defective motor	Check	
Inaccurate feed	Stepping motor power control board	Check	9-4-3
	CPU board	Check	9-4-3
	Loose flexible coupling	Tighten fastening screws	9-6
	Tight cylinder	Check, replace if necessary	9-8
	Seized guide wedges	Check, smooth, lubricate	9-8
	Defective motor	Check	
No retraction	Stepping motor power control board	Check	9-4-3
	CPU board	Check	9-4-3
	Opto sensor board	Check	9-7
	Stepping motor power control board	Check	9-4-3

Error	Cause	Remedy	Ref.
Handwheel brake not effective	Bolt not engaged	Check, adjust	9-3
Not possible to change the section thickness	CPU board Stepping motor Loose flexible coupling	Check Check Check	9-4-3 9-6 9-6
Not possible to change between TRIM and FEED	Display	Check	9-4-1
Keyboard faults	Defective keyboard CPU board	Check Check	9-4-1 9-4-3
LED in keyboard without function	Defective keyboard CPU board	Check Check	9-4-1 9-4-3
No cooling power	Leaky compressor Valve Defective contactor Voltage supply	Check Check Check Check	9-13 9-14 9-12 4-3
Insufficient cooling power	Leaky condenser Site of installation Ambient temperature Ventilation Frost built-up on evaporator	Clean Check Check Check Check defrosting time, check temperature sensor	9-14 9-14 9-14

8-3 Adjustment of knives

According to the facette of C and D knives select a clearance angle of 5 - 15° and note the correct setting of the knife height. For disposable blades select a clearance angle of 10 - 12°.

8-4 Readjusting knife carriers

To be able to adjust the knife carrier, loosen the threaded pin (fig. 10.1) on the right side of the base plate (fig. 10.7).
To achieve a tighter or looser clamping, turn the adjusting bush (fig. 10.4) forwards or backwards by means of the pin via the holes (fig. 10.3).
To move the clamping position of the lever backwards, turn the adjusting bush (fig. 10.4) backwards.
To move the clamping position of the lever forwards, turn the adjusting bush (fig. 10.4) forwards.
After the adjustment, tighten the threaded pin (fig. 10.1) again.

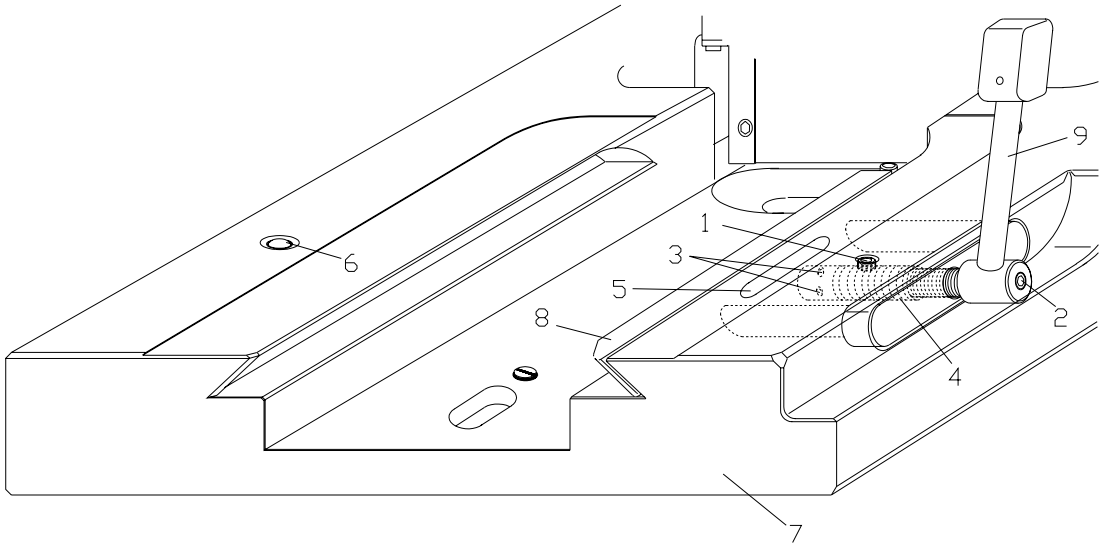

Fig. 10

1 = Threaded pin
2 = Threaded pin
3 = Hole
4 = Adjusting bush
5 = Hole
6 = Thrust piece
7 = Base plate
8 = Clamping ledge
9 = Clamping lever

8-5 Readjusting the orienting specimen head

It is possible to adjust the clamping force as well as the position of the lever (fig. 11.9) on the orienting specimen head (fig. 11.1).

Remove the orienting specimen head (fig. 11.1) from the cylinder (fillister head screw M8x25).
For the exact adjustment of the lever, insert and clamp a specimen chuck. On the rear side of the orienting specimen head (fig. 11.1) there is a threaded pin (fig. 11.7) locking the threaded bush (fig. 11.5).
Turn the lever (fig. 11.9) in a counter-clockwise direction, to remove it. After having removed the lever (fig. 11.9), loosen the threaded pin (fig. 11.7). The threaded ring (fig. 11.5) can now be adjusted by means of a large screwdriver. Turning to the right side (clockwise) to tighten the clamping, turning to the left side (counter-clockwise) the clamping is loosened. After having adjusted the threaded ring (fig. 11.5), tighten the threaded pin (fig. 11.7) again.
Mount the lever (fig. 11.9) again. The ideal position of the lever (fig. 11.9) should be at approx. 90°. This way, the lever cannot get in contact with the microtome housing or the knife carrier.

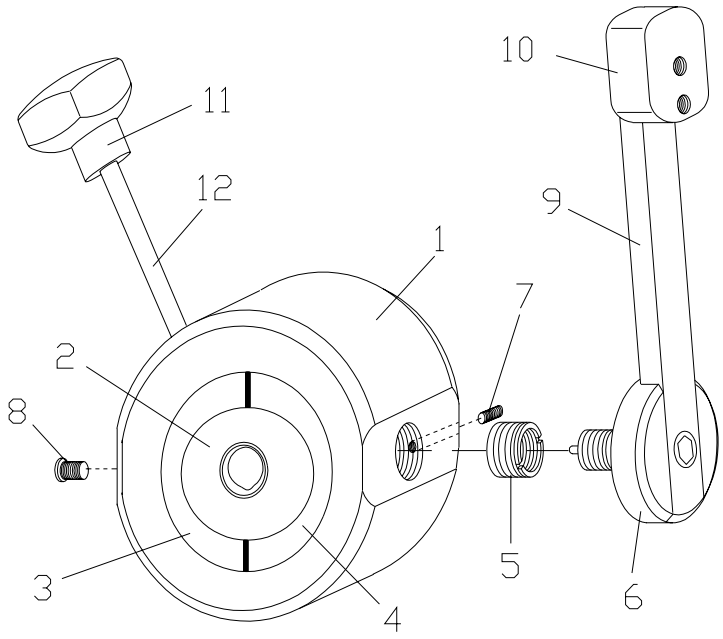

Fig. 11

1 = Head
2 = Ball piece
3 = Ball shell
4 = Ball shell
5 = Threaded ring
6 = Threaded bush
7 = Locking screw M4x8
8 = Screw
9 = Lever
10 = Handle
11 = Star handle
12 = Threaded pin

8-6 Adjusting the ross roller bearings

The adjustment of the cross roller bearings is carried out via the rail fastened on the left side of the frame. However, the other three guide rails must be inserted properly and the screws must securely be tightened.
To adjust the cross roller bearings, first loosen the fastening screws (fig. 24.5) on the left side. Then slightly tighten these screws again so that the rail is still in its position but can be moved from the left side by means of the threaded pins. Mediate the roller cages not touching top or bottom. Tighten the six adjusting screws in their holes (fig. 24.9) with a torque of 6 Ncm by means of a torque wrench. During this setting, the horizontal cylinder should always have the same position as the threaded pin to be tightened. Then tighten the fastening screws of the rail (fig. 24.5). The rail cannot be moved anymore.
Then check the cross roller bearings by up and downward movements of the horizontal cylinder.
To check the cross roller bearings again, loosen the six threaded pins in their holes (fig. 24.9) once more and tighten them with the above-mentioned torque. Again move the horizontal cylinder up and downwards and check for zero-backlash. Then mount the end pieces.

8-7 Link block

To be able to check and clean the link block, remove the microtome from the instrument (see shaft with bearing, link block, part 9-9).

Before installing a new link block, clean the slide hook (fig. 4.4), the link block (fig. 4.2) as well as the cylinder pin (fig. 4.1) of the crank arm (fig. 4.5).
When installing the new link block, please note the smooth running. Before re-installing the slide hook (fig. 4.4), the link block (fig. 4.2) as well as the cylinder pin (fig. 4.1), lubricate them with Isoflex grease (cat. no. 350140).

8-8 Checking the feed by means of a dial gauge

Remove the microtome housing, place the dial gauge holder on the thread (fig. 19.3) via the screw. The pin of the dial gauge must touch the front side of the cylinder. Set the feed value on the control panel. Then compare this value with the feed carried out by the stepping motor. The correct retraction value must be 40 µm.

To check the microtome outside the cryostat, we offer a checking line (elongation line) of 2,5 m available under cat. no. 614150.

To check the automatic approach system also outside the cryostat, we offer a checking line of 2,5 m available under cat. no. 614170.

8-9 Checking the cable connections

If no feed is carried out, having verified this by means of a dial gauge (see part 8-8), check all the cable connections. Beware that the contacts of the cable connections are not bent or broken.

8-10 Measuring points

To supply the different circuit areas on the CPU board (fig. 18.11), three supply voltage systems are needed. The CPU board has measuring points for faultless values, which can be measured by means of a voltage meter.

Supply voltage digital electronics

TP1 GND digital

TP2 GND digital

TP3 Supply voltage digital

TP4 Supply voltage control panel

TP5 Unregulated supply voltage digital

TP 1/TP2 → TP3	=	4,75 VDC - 5,25 VDC
TP1/TP2 → TP4	=	4,75 VDC - 5,25 VDC
TP1/TP2 → TP5	=	12 VDC - 17 VDC

Supply voltage stepping motor drive

While in troublefree standby, measure on CONN 3, pin 7 and 8 of the CPU board a voltage between 27,2 VDC and 35,0 VDC by means of a voltage meter.
This voltage can also measured directly on the condenser C21 on the CPU board.

8-11 Table of the diagnostic LEDs

Four LEDs are placed on the triac board (fig. 6a.24) for easy diagnostics in the microtome-cyrostat HM 505 E.
Below table shows the corresponding reference of the LEDs. When a LED lights up, this means that the corresponding function is activated.

Below-listed is also the assignment of the connector CONN 3 on the triac board. This connector is connected to CONN 2 on the CPU board via a 5-lead wire connection.

No. of the diagnostic LED	Description of the function	Connector CONN 3 on triac board
D 1	Cooling valve	1
D 2	Defrosting valve (bypass valve)	2
D 3	Cooling chamber illumination	3
D 4	Peltier cooling station	4
--	GND	5

8-12 Error code diagnostics

The instrument has an error code indication to define faster and better occurring malfunctions.

Error code E-01

The error code E-01 is shown on the left display (fig. 12.10) and indicates that there is a malfunction in the power electronics of the instrument.
In this case, the windings of the stepping motor can be defective.
Another possibility could be a defective control board. The proper functioning of this board is controlled by the green LED on this board. An inactive LED shows that either the board itself is defective or that there is a disturbance in the power supply (see exchanging the control power board part 9-4-3).
When the supply voltage (24 VAC) on CONN 6 of the CPU board or the supply voltage (28,5 - 32,5 VDC) of the stepping motor power control board (CONN 3, pin 7 and 8 on CPU board) is missing, this is shown as error code E-01 on the display. Please check the voltage supply.

Error code E-02

The error code E-02 is also shown on the left display (fig. 12.10) and indicates that the battery for the stored data is empty. In this case, the battery must be replaced (see part 9-5).

Error code E-03

The error code E-03 is shown on the right display (fig. 12.18). This error code helps to avoid that a wet or humid microtome is cooled down and, consequently the guides freeze solid. For this reason, the temperature of the cooling chamber is measured immediately after turning on the instrument. When the temperature is higher than 0°C, the error code E-03 is shown on the display and indicates that no cooling process was carried out for a longer time caused by power failure or turning off the instrument. Before starting working again, make sure that the microtome is in a perfectly dry condition. Then press button (fig. 12.13).

Error code E-04

The error code E-04 is shown on the left display (fig. 12.10) if the back end position of the integrated feed system is not reached within two minutes after turning on the instrument. First, check the position of the horizontal cylinder.

The exact measures for the front and rear end position are defined by the distance between the front edge of the horizontal cylinder (fig. 3.17) and the front edge of the cylinder guide (fig. 3.15). If the horizontal cylinder is in the rear end position, the distance must be 7,8 mm with a tolerance of +/- 0,5 mm. If the horizontal cylinder is in the front end position, the distance must be 35,7 mm +/- 0,5 mm.

If the horizontal cylinder has not been moved to the back end position, there is a driving problem of the integrated feed system, e.g. the cylinder is too tight, the clutch is loose on the stepping motor or on the spindle.

If the horizontal cylinder is in the front end position (35,7 mm +/- 0,5 mm tolerance), it can be assumed that the feed system got stuck by another malfunction. Turn the spindle with the special key (cat. no. 362110). Turn on the instrument again.

If the horizontal cylinder is in the back end position (7,8 mm +/-0,5 mm tolerance) although the error code E-04 is shown on the display, it can be assumed that the back end position was not detected by the opto sensor board. Moreover, you have to reckon in this error case that the drive got stuck in the mechanical back end position. Turn the spindle with the special key (cat. no. 362110).
Moreover, check if the connector on the post connector of the opto sensor board is connected properly.

Error code E-05

The error code E-05 is shown on the right display (fig. 12.18) in case the activating signal for the automatic approach system has already been recognized before the automatic approach system was started. This might be possible, in case a specimen has already been in contact with the knife edge, e.g. by protuding fibers. If this cause of trouble is eliminated, press button (fig. 12.13). The error code E-05 goes off and sectioning can be continued.
However, if there is no obvious explanation for the error code E-05, it can be assumed that there is an insulation defect between pre-amplifier input and ground. This can result for example from condensed humidity on the pre-amplifier or from a leaking current to a grounded part. Removal by checking and drying. If the removal is not possible, replace the pre-amplifier (see part 9-11).

Error code E-06

The error code E-06 is also shown on the right display (12.18) in case the actual temperature is warmer than -5°C. Above this temperature, the automatic approach system cannot be activated. Press button (fig. 12.13) to clear the error code E-06.

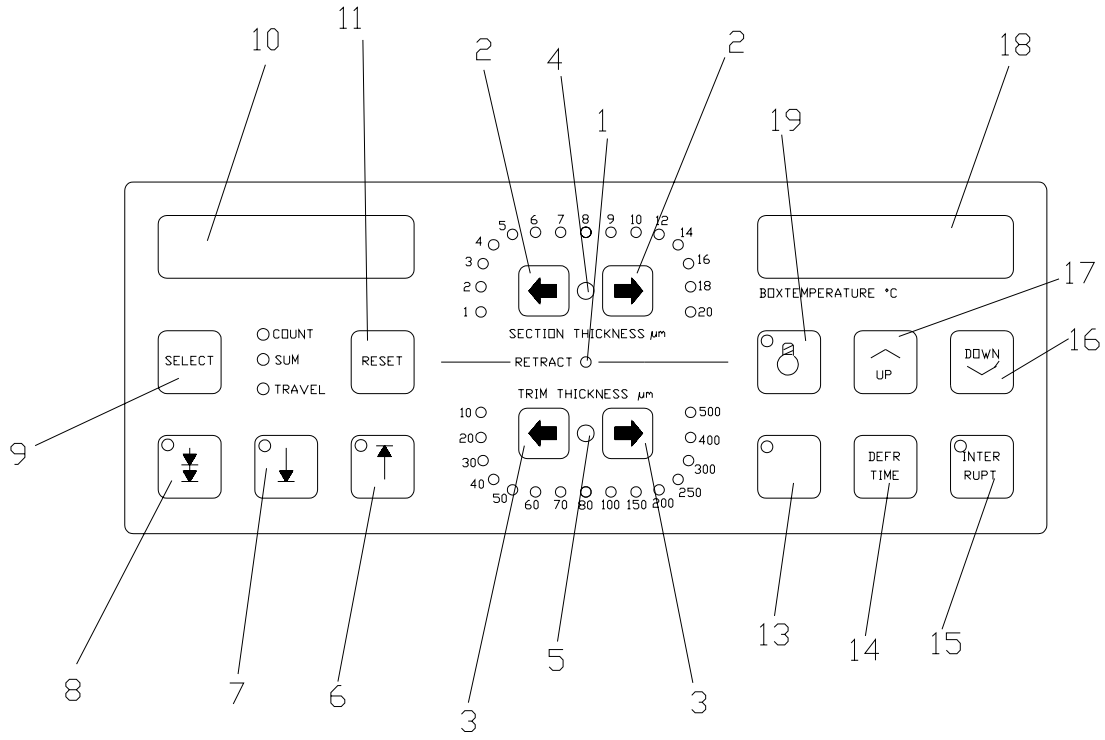

Fig. 12

1 = LED retraction
2 = Section thickness setting
3 = Trimming thickness setting
4 = LED
5 = LED
6 = Coarse feed backwards
7 = Coarse feed forwards
8 = Trimming
9 = Select
10 = Left display
11 = Reset
13 = Clear/automatic approach system
14 = Defrosting time
15 = Interruption/defrosting
16 = DOWN
17 = UP
18 = Right display
19 = Illumination

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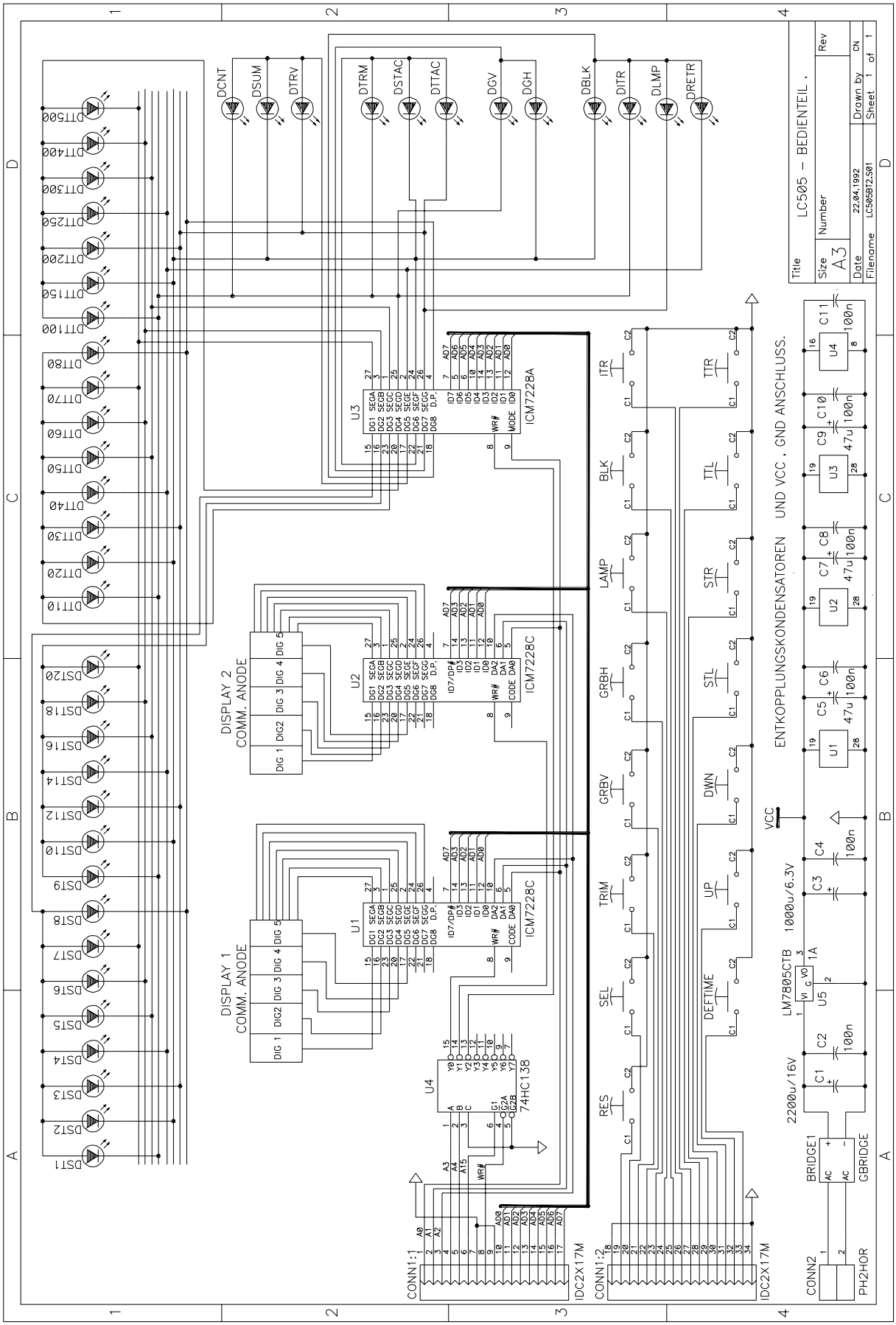

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Part 9 Exchanging and adjusting assemblies and spare parts

9-1 Microtome

If service work should become necessary on the microtome, dismount the instrument from the cooling chamber as follows:

Turn off the instrument on the power switch. Pull the mains plug off. Remove or suck off cold section waste. Remove the knife from the knife carrier and store it in a knife case. Remove section waste tray, specimen chucks and working tools. Loosen the clamping lever on the right side of the base plate of the microtome and remove the knife carrier towards the front. Then lift the two side accessory shelves in the front, pull them out of the rear pegs and also remove them.
Suck off again cold section waste. The warming up of the microtome chamber can actively be accelerated by using a hair dryer.

CAUTION!
Before dismounting the microtome, first remove the temperature sensor from its holder which is installed on the left upper side on the microtome. Remove the coded connectors for the automatic approach system and the stepping motor.

Dismount the warm microtome as follows:

CAUTION!
Turn the handwheel into the lower position, i.e. the specimen holder is also in the lower reversal point.

Remove the 16-lead (fig. 15.2) as well as the 4-lead connection. Now loosen the Allen screw (fig. 13.1) in the middle of the front part of the microtome base plate via an Allen key size 5 mm. Then slightly lift the microtome base plate (fig. 13.2) and move it approx. 2 cm to the left side until the clutch (fig. 13.3) on the right side of the microtome is free. Then pull the microtome to the front to loosen it from the rear adjusting stop (fig. 13.4). Turn the microtome to the right side so that the frontside of the microtome faces the right side wall of the chamber.

Carefully take the microtome out and immediately remove all loose waste by using a brush.

Thoroughly clean and wash the interior of the cooling chamber. Open the stopper on the bottom of the cooling chamber. The waste detergent can be collected again at the end of the outlet (left side wall). Insert the stopper after cleaning as otherwise cold air leaks out while in operation and the instrument will cover with frost.

After having finished the service work, install the microtome in reverse order.
Before, however, please note that the microtome is absolutely dry to avoid that the nut with spindle or the cylinder guide freeze solid.

CAUTION!
The handwheel must be in the lower position when the microtome is inserted into the clutch.

When inserting the microtome, please note that the base plate is pushed below the adjusting stop (fig. 13.4).
The three plastic screws on the base plate can be used to adjust the microtome as needed.

Afterwards, establish all connections again.

Insert accessory shelves, accessories and knife carrier into the instrument again.

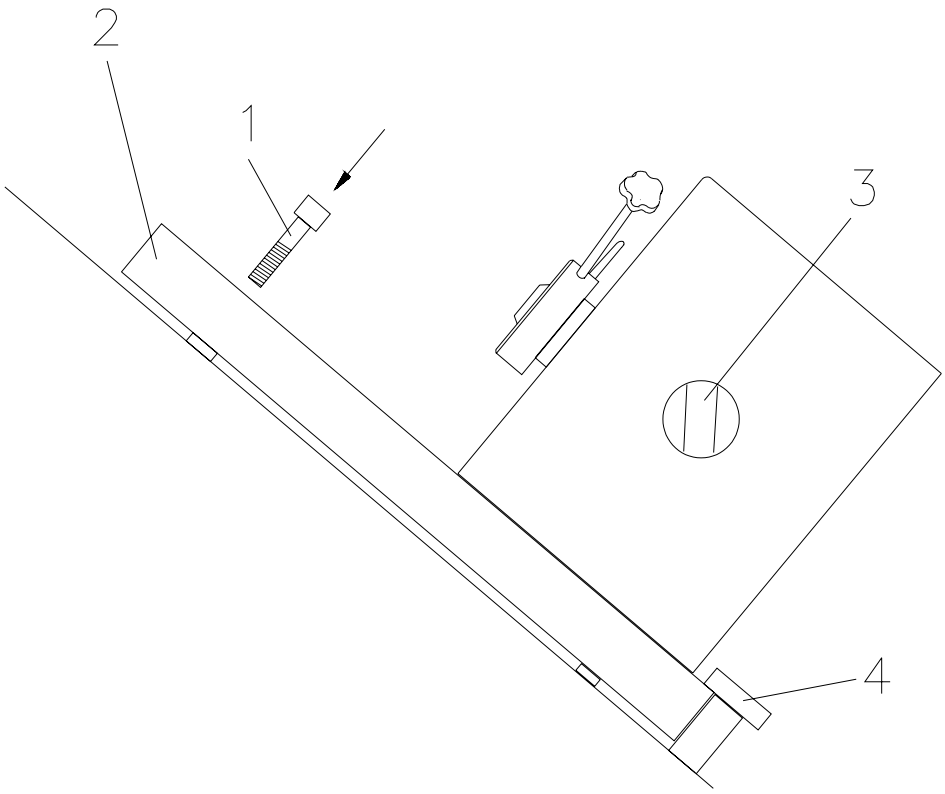

Fig. 13

1 = Allen screw
2 = Base plate
3 = Oldham clutch
4 = Adjusting stop

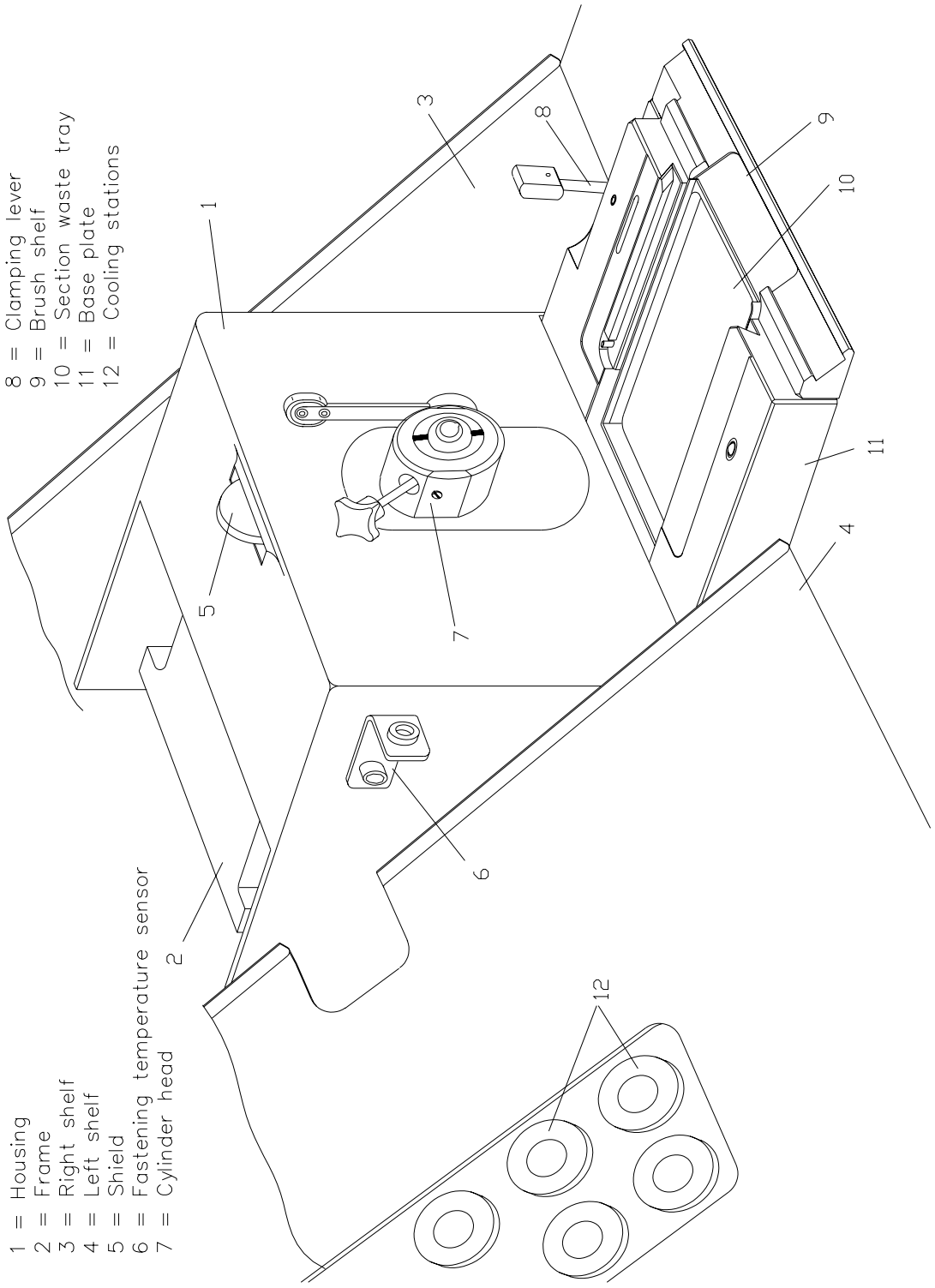
1 = Housing
2 = Frame
3 = Right shelf
4 = Left shelf
5 = Shield
6 = Fastening temperature sensor
7 = Cylinder head
8 = Clamping lever
9 = Brush shelf
10 = Section waste tray
11 = Base plate
12 = Cooling stations

Fig. 14

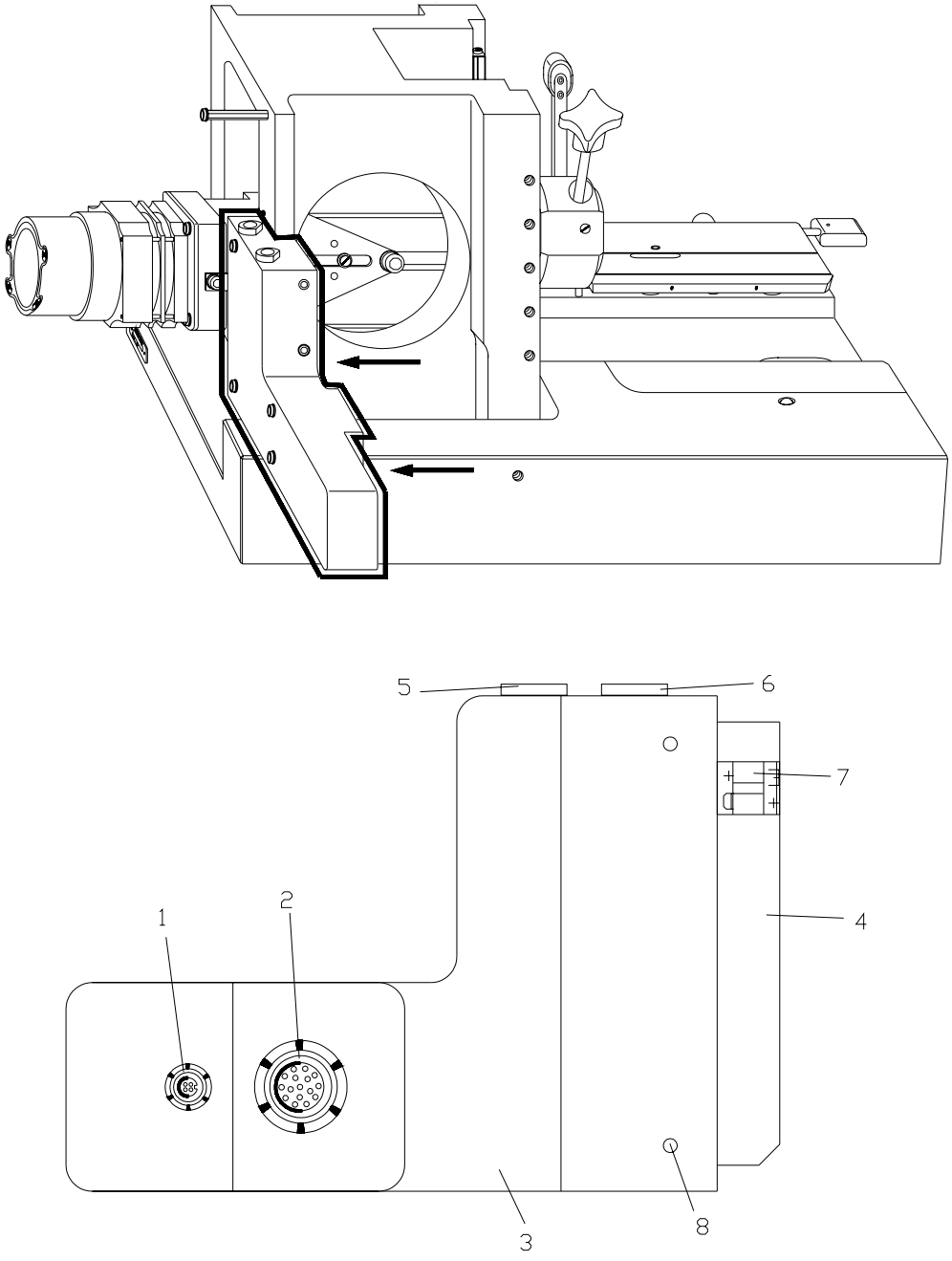

Fig. 15

1 = Connector socket f. automatic approach system
2 = Connector socket f. stepping motor
3 = PC board housing
4 = PC board
5 = Cable leadthrough
6 = Cable leadthrough
7 = Light barrier
8 = Fastening

9-2 Handwheel drive

To be able to dismount the drive support (fig. 16.1), first open the top cover (fig. 1.1) of the cryostat, dismount the handwheel (fig. 16.16) and remove the right side wall (fig. 2.5).

To dismount the handwheel (fig. 16.16), carefully remove the cover disk (fig. 16.12) by means of a flat screwdriver. For this, please note that the handwheel handle is in its lower position, to make sure that the horizontal cylinder of the microtome is also in its lower position. If not, the horizontal cylinder can slide downwards because the counterweight of the handwheel (fig. 16.16) is missing.
Loosen the Allen screw by means of an Allen key size 6 and remove the handwheel (fig. 16.16). When doing so, please note that you do not lose the handwheel locking with pressure spring (fig. 16.5).

Before opening the top cover (fig. 1.1), open the sliding window (fig. 1.3) and loosen the two screws which are situated on the front inner edge of the top cover. Please note that the inserted distance washers do not fall into the interior of the cooling chamber. Afterwards close the sliding window (fig. 1.3) again and tightly fix it with adhesive tape preventing the sliding window from sliding down when opening the top cover (fig. 1.1). Use the holding support (fig. 2.24), which is placed on the left side of the instrument, to support the top cover (fig. 1.1) when opening it.

Remove the right side wall (fig. 2.5) as follows:
First loosen the visible screws (fig. 2.21) on the outside of the instrument. Then loosen the two nuts (fig. 2.27) from the interior side. Lift the right side wall (fig. 2.5) from the peg (fig. 2.8) and remove it.

To replace the drive support (fig. 16.1), dismount the microtome (see part 9-1, microtome).
Loosen the clamping bolt (fig. 16.4) and remove the toothed belt (fig. 16.15).
Warm up the groove nut (fig. 17.14) by means of a hair dryer and loosen it with a sickle spanner (size 30 - 32). Then remove the toothed wheel (fig. 17.13). Remove the feather key (fig. 17.7). Carefully push the shaft (fig. 17.5) to the interior side by means of a rubber mallet. Loosen the four Allen screws (fig. 16.14). This way, the entire drive support can be removed.

The installation is carried out in reverse order.

CAUTION!
After having installed the drive support (fig. 16.1), the toothed wheel (fig. 17.13) and the groove nut (fig. 17.14), the shaft (fig. 17.5) must turn smoothly.

After having installed the handwheel, a new cover disk must be inserted, as the old one cannot be used anymore.

9-3 Mounting and dismounting, adjusting the handwheel lock

The installation or removal or the handwheel is carried out as described in part 9-2 (handwheel drive).

When installing the handwheel lock, please note that the bolt (fig. 16.8) is without burrs and old grease. The pressure spring (fig. 16.5) should also be in a good shape.
Before re-installing the bolt (fig. 16.8) put some grease (cat. no. 350140) on it.
The protruding part of the pin (fig. 16.6) must show when installing, as otherwise the movement of the bolt (fig. 16.8) would be limited. The depth of the bolt (fig. 16.8) of the handwheel lock can be adjusted via the adjusting screw (fig. 16.9). Turn the adjusting screw (fig. 16.9) in a clockwise direction, the bolt (fig. 16.8) will be pushed less deeply into the locking hole. Turn the adjusting nut (fig. 16.9) in a counter-clockwise direction, the bolt is pushed deeper into the locking hole.
If the handwheel with handwheel locking is mounted, check the proper function of the handwheel lock. The bolt (fig. 16.8) must not graze the drive support (fig. 16.1).

When the handwheel lock is locked, the handwheel (fig. 16.16) must not turn. The lever (fig. 16.10) must remain in the closed position and must not recoil.

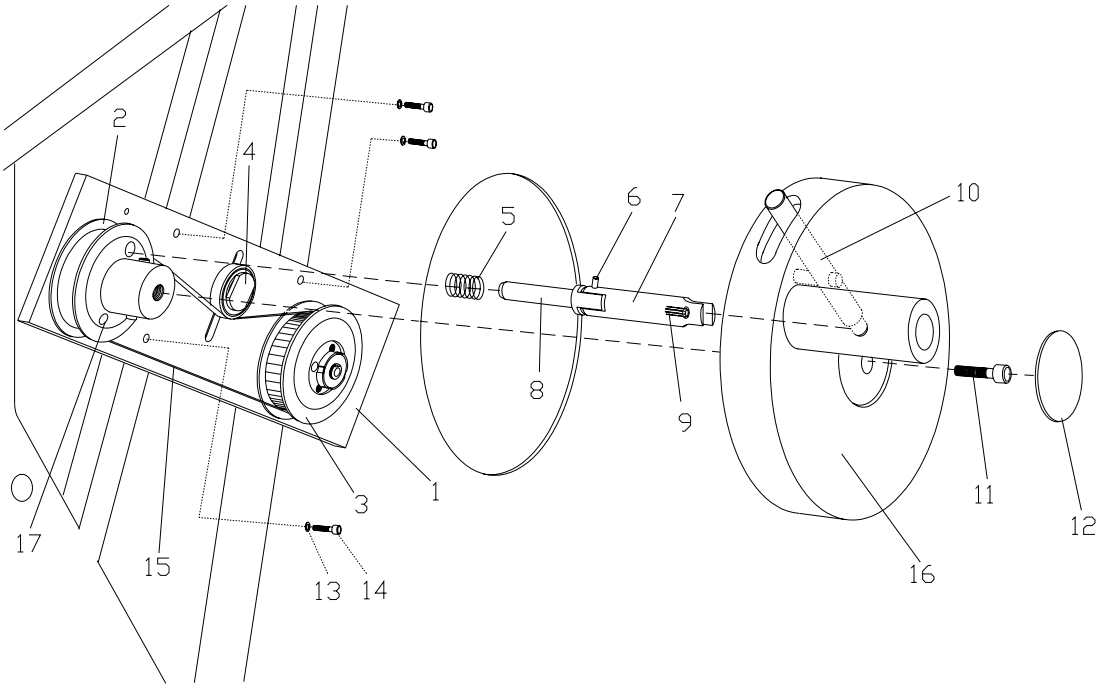

Fig. 16

1 = Drive support
2 = Toothed wheel
3 = Toothed wheel
4 = Clamping bolt
5 = Pressure spring
6 = Pin
7 = Connecting rod
8 = Bolt
9 = Adjusting screw
10 = Lever
11 = Allen screw
12 = Cover disk
13 = Plain washer
14 = Allen screw
15 = Toothed belt
16 = Handwheel
17 = Locking hole

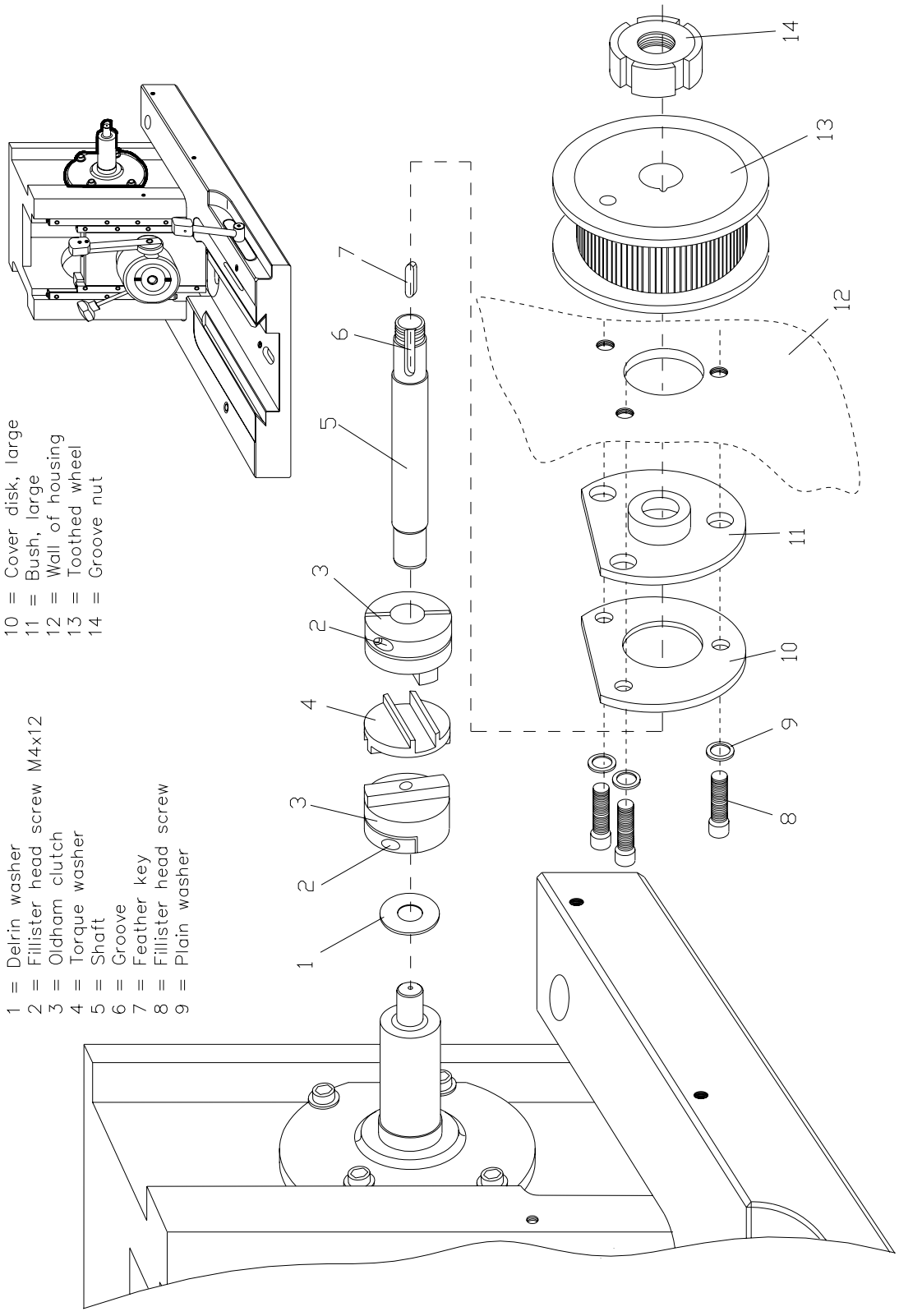
1 = Delrin washer
2 = Fillister head screw M4x12
3 = Oldham clutch
4 = Torque washer
5 = Shaft
6 = Groove
7 = Feather key
8 = Fillister head screw
9 = Plain washer
10 = Cover disk, large
11 = Bush, large
12 = Wall of housing
13 = Toothed wheel
14 = Groove nut

Fig. 17

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9-4 Top cover of the instrument

The following parts are mounted in the top cover:

- Keyboard (fig. 18.7)
- Fluorescent lamp (fig. 18.9)
- Starter for fluorescent lampe (fig. 18.10)
- CPU board (fig. 18.11)
- Stepping motor control power board (fig. 18.12)
- Power switch (fig. 18.3)

If maintenance or replacement work is necessary on the a.m. part, first turn off the instrument and pull the mains plug. Then close the window towards the front, lift it and then pull it to the front and fold it backwards. Put a soft pad underneath it.

CAUTION! Make sure that the sliding window does not slip down!!

Loosen the screws on the right and left side of the top cover on the rim of the cooling chamber so that the top cover can be opened upwards via the two hinges (fig. 18.2). The top cover can be supported via the holding support (fig. 2.24) placed in the left side wall.

You now have access to the above-mentioned parts for service and replacement work.

9-4-1 Keyboard

To replace the keyboard, first open the top cover as described above (part 9-4).

The keyboard (fig. 1.2) is fastened on the rear side of the PC board on six stud bolts via six threaded bushs M3 (wrench size 5). Loosen the 34-lead plug connection as well as the 2-lead 11-volt voltage supply on the rear side of the keyboard.
Then turn out the six threaded bushs M3 (SW 5). Now remove the keyboard from the top cover (fig. 1.1) towards the front.
The six nuts M3 which are placed on the threaded bolts of the keyboard must be removed from the defective keyboard and screwed onto the threaded bolts of the new keyboard. These six nuts M3 are used to adjust the height of the keyboard.
Carefully push the keyboard (fig. 1.2) into the intended opening of the top cover (fig. 1.1).
The keyboard should be placed inset by 0,5 mm in the hole and sit horizontally, as otherwise, when tightening the six threaded bolts, the keyboard might break up.
Tighten the keyboard via the six threaded bolts M3 (wrench size 5). Again establish the 34-lead plug connection (safety ground connection is tightened below the threaded bolt) as well as the 2-lead 11-volt voltage supply.

Check the keyboard functions and the real time as well as the defrosting time.

9-4-2 Fluorescent lamp and starter

On the left side, the lamp is inserted into a bracket and on the right side it is clamped by a flexible clip.
Pull the lamp downwards out of this clip. Then pull it to the left side out of the bracket.
Change the lamp against a new one.

NOTE! Only use the lamp type (PL-L 18 W 84 4P), which was installed in the factory.

First insert the lamp into the bracket. Then carefully press the lamp back into the clip.

To replace the starter (fig. 18.10), turn it to the left side and pull it off. Push the new starter inwards and turn it to the right side.

9-4-3 CPU board and stepping motor power control board

The two electronic boards (fig. 18.11 and 18.12) are fastened via four nuts each. To exchange these boards, loosen the nuts from the threaded bolts. Pull the corresponding connectors off and remove the boards.

CAUTION!
Before dismounting, mark the individual cables to avoid a faulty connection during re-installation.

The installation of the boards is carried out in reverse order.

After having exchanged the CPU board, set the real time and defrosting time.

Software reset

In case a CPU board or an e-prom must be replaced, a software reset must be carried out. Turn off the mains switch (fig. 18.3) of the instrument. Press the reset button (fig. 12.13) on the operating panel and keep it pressed.
Turn the mains switch on again. However, keep the reset button (fig. 12.13) pressed for approx. 2 sec.
Afterwards, the stepping motor moves into the calibration position.

9-4-4 Power switch

To be able to replace the power switch (fig. 18.3), pull off the quick-connect receptacle. Then push the power switch backwards out of the clip mechanism.

The installation of the new power switch is carried out in reverse order.

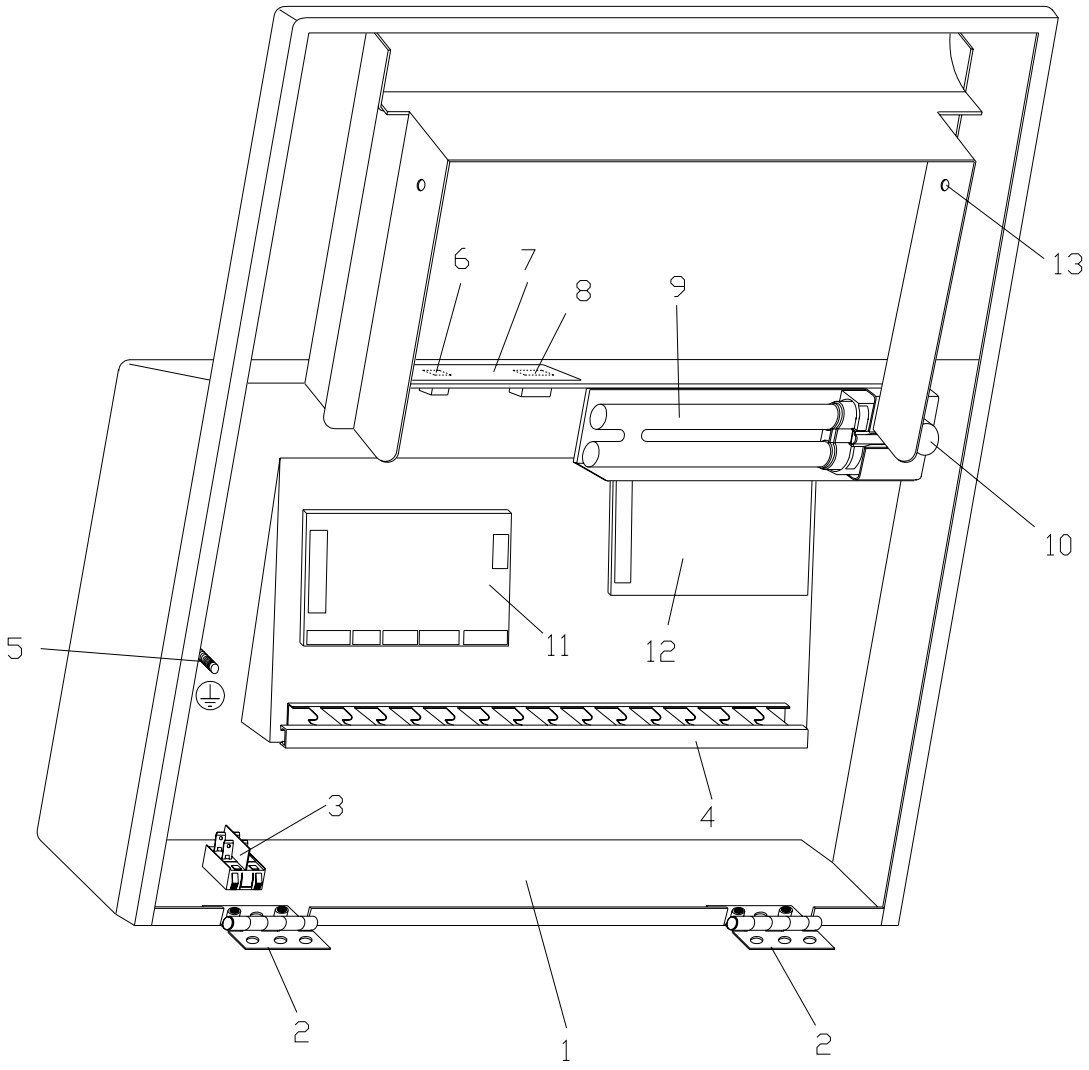

Fig. 18

1 = Top cover
2 = Hinge
3 = Power switch
4 = Cable channel
5 = Fastening safety ground conductor
6 = LED display
7 = Touchpad keyboard
8 = LED display
9 = Fluorescent lamp
10 = Starter
11 = CPU board compl.
12 = Stepping motor power control board
13 = Fastening top cover

9-5 Battery for stored data

Turn off the instrument. Replace the IC MK 48T87B with the integrated battery on the CPU board. Then press the RESET button (fig. 12.11) and turn on the instrument while the RESET button (fig. 12.11) is still being pressed.

9-6 Stepping motor and micrometer mechanism

> **CAUTION!** To avoid wrong connections when re-installing the individual cables, mark them before you start to dismount them.

First loosen the cables (fig. 15.2 and 15.1). Next, dismount the microtome (see part 9-1). To loosen the flexible coupling (fig. 19.24) from the end of the micrometer spindle (fig. 19.15), unscrew the Allen screw (fig. 19.23) through one of the holes (fig. 19.26) on the distance sleeve (fig. 19.25) by means of an Allen key, size 2,5. After having loosened the screw (fig. 19.30) on the distance sleeve (fig. 19.25) pull off the stepping motor with distance sleeve (fig. 20.15 and 20.21) and flexible coupling (fig. 19.24) backwards.
To remove the stepping motor, loosen the screw (fig. 20.16) on the distance sleeve (fig. 20.15). Now remove the stepping motor together with the flexible coupling (fig. 19.24). To loosen the flexible coupling from the axle of the stepping motor, loosen the screw on the flexible coupling by means of an Allen key.

To remove the micrometer mechanism from the cylinder guide, proceed as follows: Loosen the screws (fig. 19.20) to remove the bearing disk (fig. 19.19) from the monobloc. Then push the cylinder backwards. Place the special key (cat. no. 362090) for micrometer nut between bearing disk and monobloc. If the gap between monobloc and distance disk is too narrow, turn the micrometer spindle backwards by means of the key for micrometer spindle (cat. no. 362110) by the required distance. Insert the special key (cat. no. 362090) with pins (fig. 9.1) into the pocket holes of the micrometer nut (fig. 19.13) and unscrew the micrometer nut from the horizontal cylinder in a counter-clockwise direction. Remove the micrometer mechanism backwards.

To disassemble the micrometer mechanism into its individual parts, loosen the threaded ring (fig. 19.22). Pull the threaded ring (fig. 19.22), the equalizing disks (fig. 19.21), the axial bearing disks (fig. 19.18), the axial needle wheel (fig. 19.17 and the axial disk (fig. 19.18) off the micrometer spindle (fig. 19.14). To further disassemble the micrometer nut (fig. 19.13) and the counternut (fig. 19.10), unscrew the micrometer spindle.

To assemble the micrometer nut (fig. 19.13) and the counternut (fig. 19.10), screw the micrometer spindle (fig. 19.14) into the micrometer nut (fig. 19.13). Insert the springs (fig. 19.11). Press the micrometer nut (fig. 19.13) and counternut (fig. 19.10) together with a distance of 3,0 mm, searching for the thread of the counternut (fig. 19.10) by means of the micrometer spindle. Measure the distance between micrometer nut and counternut. The distance must be between 3,0 and 3,2 mm. If you get other values, turn the counternut, i.e. remove it and turn it in a clockwise or counter-clockwise direction and insert it again onto the springs (fig. 19.11) and pins (fig. 19.12).
Again press micrometer nut (fig. 19.13) and counternut (fig. 19.10) together with a distance of 3,0 mm and search for the thread of the counternut. Once more measure the distance. Only if a distance between 3,0 and 3,2 mm is measured between micrometer nut and counternut continue with the assembly. Lubricate the micrometer spindle (fig. 19.14) and micrometer nut (fig. 19.13), when assembling them.

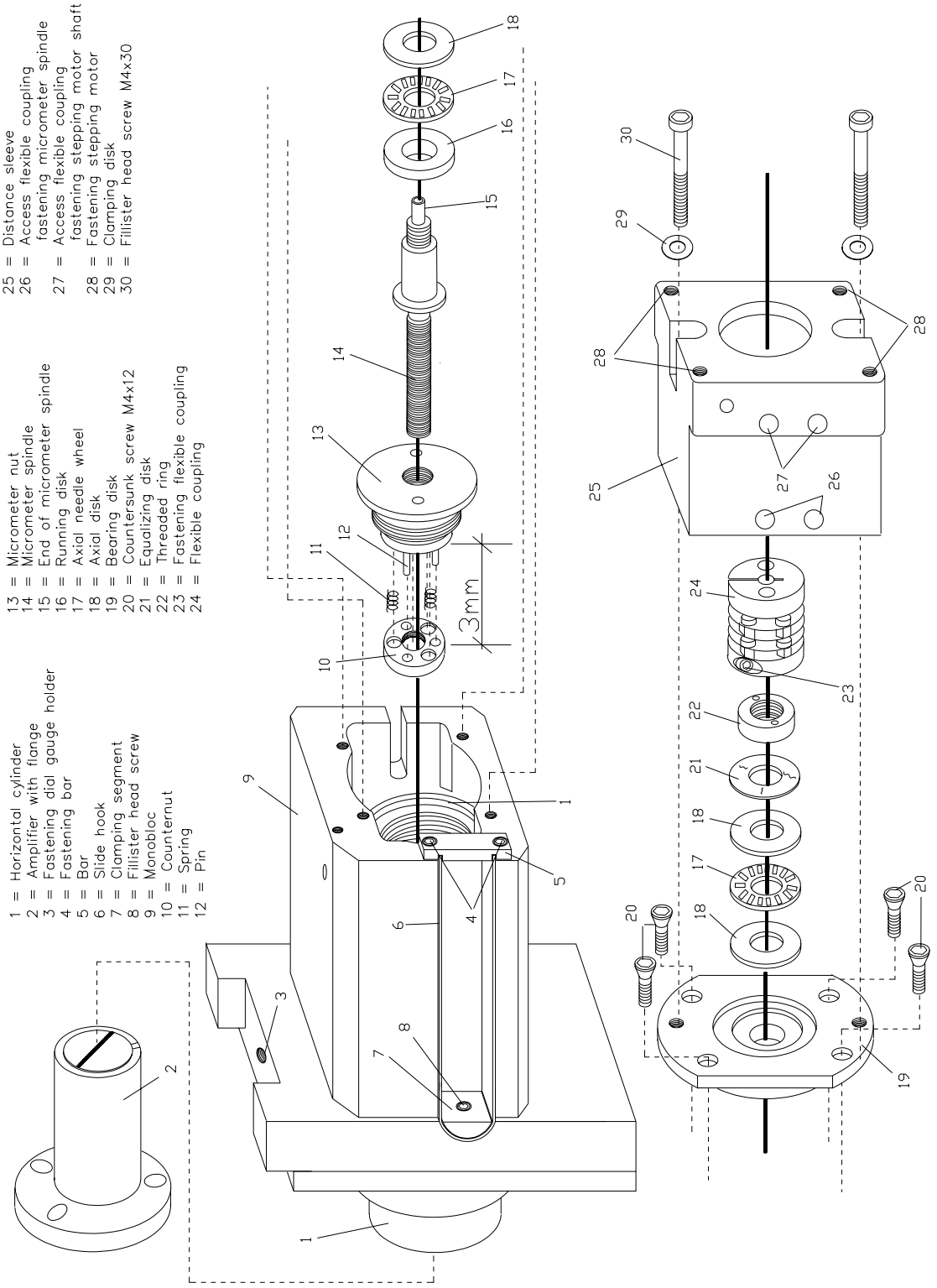
1 = Horizontal cylinder
2 = Amplifier with flange
3 = Fastening dial gauge holder
4 = Fastening bar
5 = Bar
6 = Slide hook
7 = Clamping segment
8 = Fillister head screw
9 = Monobloc
10 = Counternut
11 = Spring
12 = Pin
13 = Micrometer nut
14 = Micrometer spindle
15 = End of micrometer spindle
16 = Running disk
17 = Axial needle wheel
18 = Axial disk
19 = Bearing disk
20 = Countersunk screw M4x12
21 = Equalizing disk
22 = Threaded ring
23 = Fastening flexible coupling
24 = Flexible coupling
25 = Distance sleeve
26 = Access flexible coupling fastening micrometer spindle
27 = Access flexible coupling fastening stepping motor shaft
28 = Fastening stepping motor
29 = Clamping disk
30 = Fillister head screw M4x30
3mm

Fig. 19

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9-6-1 Torques on the feed spindle

The completely assembled spindle has a defined torque. It is determined by force measurement (below-mentioned method). A value between 140 and 190 cN is to be expected. For an uncoupled motor, the value is between 100 - 130 cN (centi Newton).

This value was determined with a special torque measurement device (cat. no. 358170) (fig. 9) and a spring scale (cat. no. 362080).

Measuring the torque:

Turn off the instrument. Unscrew the specimen clamping. Insert measurement device into the brass cylinder. Turn the measurement device until a latching can be noticed. Turn the measurement device to the right side (clockwise). Press the measurement device on its measuring point (ball-shaped end piece) downwards via the spring scale showing the measured value.

The position of the cylinder when measuring the torque:

Measuring point 1: Move the cylinder backwards (near the back end position by means of the key), move it forwards by three rotations, measure force by means of spring scale (always in a clockwise direction).

Measuring point 2: Move the cylinder forwards, turn it in a clockwise direction via the key until the front side of the cylinder touches the key arm. Turn it backwards by three rotations (counter-clockwise). Press the key downwards by means of the spring scale showing the measured value.

Make sure that the clamping screws (fig. 19.23) of the flexible coupling for the micrometer spindle and for the stepping motor shaft are tightened again.
Other values than the above-mentioned ones might influence the perfect functioning of the instrument.

Divergences from the above-mentioned values bigger than 200 cN can result from the following causes:

1) Bearing on stepping motor
2) Tight cylinder in cylinder guide
3) Springs between micrometer nut (fig. 19.13) and counternut (fig. 19.10) on micrometer spindle (fig. 19.14) are loaded too strongly
4) Wrong alignment

Divergences from the above-mentioned values smaller than 130 cN can result from the following causes:

1) No connection between stepping motor and spindle (loose nuts or screws on coupling)
2) Broken spring disk (fig. 19.21) in bearing disk (fig. 19.19).

9-7 Opto sensor board

Loosen the four fastening screws (fig. 21.13) and remove the cover sheet (fig. 21.10). Then unsolder the cables on CONN 1 (fig. 21.5) and loosen the clamping screws on CONN 3 (fig. 21.6). Afterwards, loosen the nuts of the bushes (fig. 15.1 and 15.2) as well as the distance pieces (fig. 21.11) and remove the PC board (fig. 15.4).

After having inserted a new PC board, fasten it with the distance pieces (fig. 21.11) and carefully tighten the nuts of the bushes (fig. 15.1 and 15.2).

Then solder the cables for the supply of the stepping motor on CONN 1 (fig. 21.5) as follows:

CONN 1 no. 1:	yellow
CONN 1 no. 2:	white
CONN 1 no. 3:	blue
CONN 1 no. 4:	red
CONN 1 no. 5:	pink (orange)
CONN 1 no. 6:	green
CONN 1 no. 7:	grey
CONN 1 no. 8:	black
CONN 1 no. 9:	brown
CONN 1 no. 10:	violet

Now the connecting cable of the automatic approach system (fig. 25.9) is connected to CONN 3 (fig. 21.6).

CONN 3 no. 1:	blue
CONN 3 no. 2:	white
CONN 3 no. 3:	black
CONN 3 no. 4:	red

Then the cover sheet is fastened via the four fastening screws (fig. 21.13).

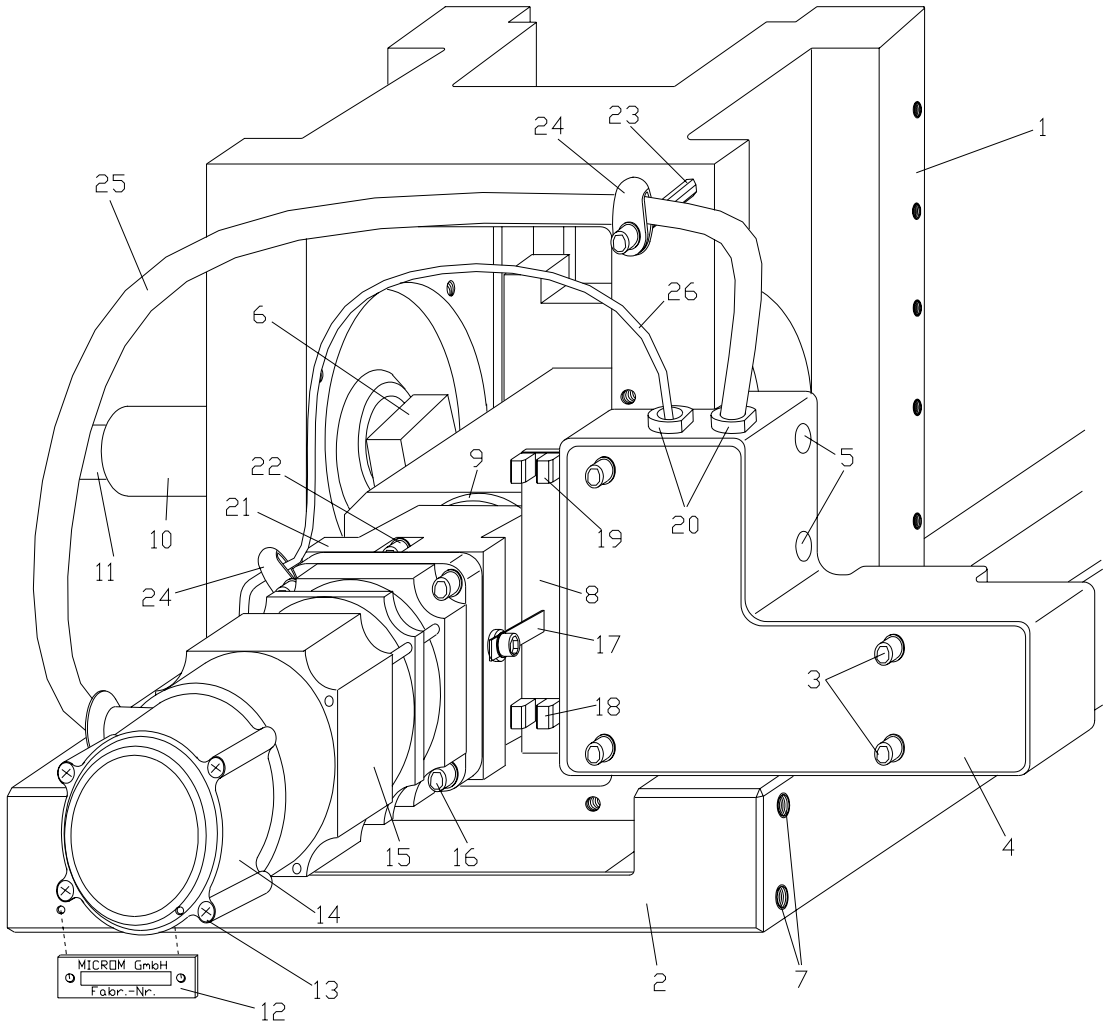


Fig. 20

1 = Frame
2 = Base plate compl.
3 = Fastening cover sheet
4 = Cover sheet
5 = Fastening
6 = Crank arm
7 = Fastening top cover
8 = Opto sensor board
9 = Bearing disk
10 = Flange
11 = Shaft
12 = Type plate
13 = Fastening
14 = Stepping motor
15 = Stepping motor
16 = Fastening
17 = Sensor plate
18 = Lower light barrier
19 = Upper light barrier
20 = Hole f. cable
21 = Distance sleeve
22 = Fastening bearing disk
23 = Distance bolt M4x60
24 = Strain relief
25 = Connecting cable stepping motor
26 = Connecting cable ACA

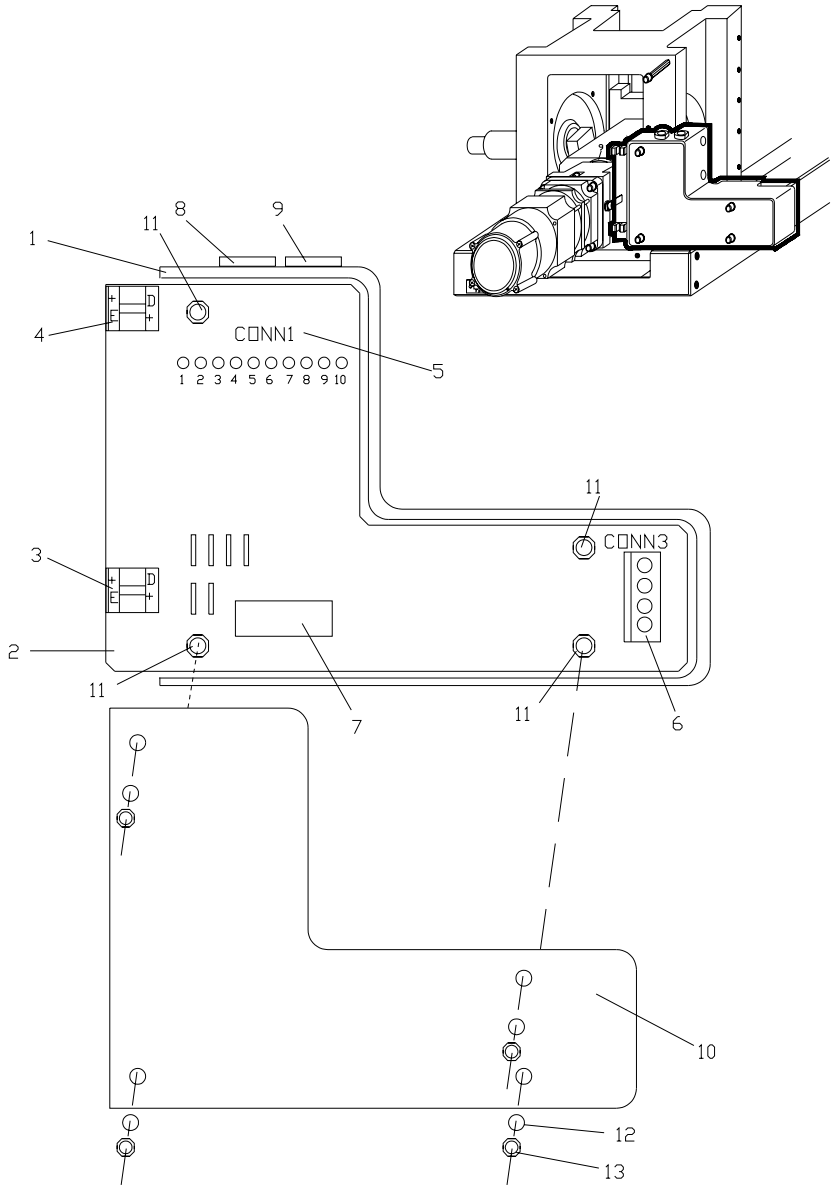


Fig. 21

1 = Housing of PC board
2 = PC board
3 = Light barrier, lower reversal point
4 = Light barrier, upper reversal point
5 = Connector 1
6 = Connector 3
7 = IC component
8 = Rubber sleeve
9 = Rubber sleeve
10 = Cover angle
11 = Distance bolt
12 = Plain washer
13 = Allen screw

9-8 Guide wedges and horizontal cylinder

To avoid turning the horizontal cylinder (fig. 22.2), guide wedges (fig. 22.4 and 22.5) are inserted in the monobloc (fig. 22.1). These guide wedges grip into the groove (fig. 22.3) of the horizontal cylinder. Two guide wedges are placed one behind the other and are slightly laterally offset. Each guide wedge completely touches a side surface of the groove (fig. 22.3). This way, each side of the groove (fig. 22.3) is guided by one wedge ensuring stability of the clyinder guide.The design of the groove does not allow the horizontal cylinder to be pulled out to the front. If the guide wedges are dismounted, the horizontal cylinder can be removed in either direction. First, however, remove the micrometer mechanism (see part 9-6).
Each guide wedge is pressed towards the groove of the horizontal cylinder by means of a spring (fig. 22.7). Each spring is supported by a peg (fig. 22.8) and together secured by a pin (fig. 22.9). This pin is visible below the horizontal cylinder. To dismount the guide wedges, carefully push the pin (fig. 22.9) backwards by means of a punch, to loosen the first peg (fig. 22.8). Remove spring (fig. 22.7) and peg (fig. 22.8). To remove the snugly situated guide wedges, use a fillister head screw M4x20 as a tool. Screw the fillister head screw into the thread (fig. 22.6) from below and pull the guide wedge (fig. 22.5) off.

CAUTION! Each guide wedge must be re-installed correctly concerning place and position. For this, mark them immediately after having removed them.

The rear guide wedge (fig. 22.4) is dismounted in the same way as the front one (fig. 22.5).
Another possibility to remove the guide wedges is to remove them upwards. First, however, the horizontal cylinder must be removed backwards.
If the guide wedges have bad or damaged surfaces, smooth them with abrasive paper (granulation 1000) and slightly lubricate them.

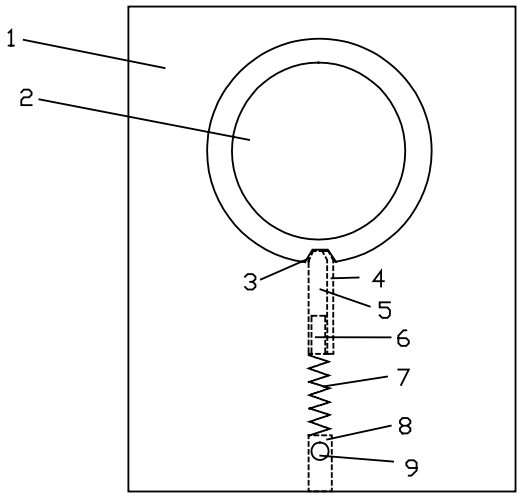


Fig. 22

1 = Monobloc
2 = Horizontal cylinder
3 = Groove
4 = Rear guide wedge
5 = Front guide wedge
6 = Thread
7 = Spring
8 = Peg
9 = Pin

9-9 Shaft with bearing, link block

To carry out service or replacement work on the shaft with bearing, dismount the microtome (see part 9-1).

Loosen the four fastening screws (fig. 23a.7) of the shaft with bearing and remove them together with the plain washers (fig. 23a.6).
Now remove the shaft with bearing. In doing so, the link block (fig. 23a.1) can remain on the crank arm (fig. 23a.2) or in the guide groove of the monobloc.

To mount and dismount the link block (fig. 23a.1), remove, check and replace it, if necessary. When mounting a new one, check for smooth running. Maybe, the link block must be adjusted by skilled grinding on abrasive paper (granulation 1000).

NOTE!
The material of the link block has been replaced by a superior one and new measure have been determined.
Besides the nomianl size of 15,00 m, link blocks with diverging tolerances of 15.02 mm or 14.89 mmare available for special needs:

Standard size:	15.00 mm, cat. no. 421050
Oversize:	15.02 mm, cat. no. 421060
Undersize:	14.98 mm, cat. no. 420630

It is not intended to further disassemble the shaft with bearing for service work. However, we recommend to completely exchange the shaft with bearing. For this, unscrew the parts 23a.7 and 23a.6 from the shaft with bearing and screw them onto the new shaft with bearing.

The installation of the shaft with bearing is carried out in reverse order.

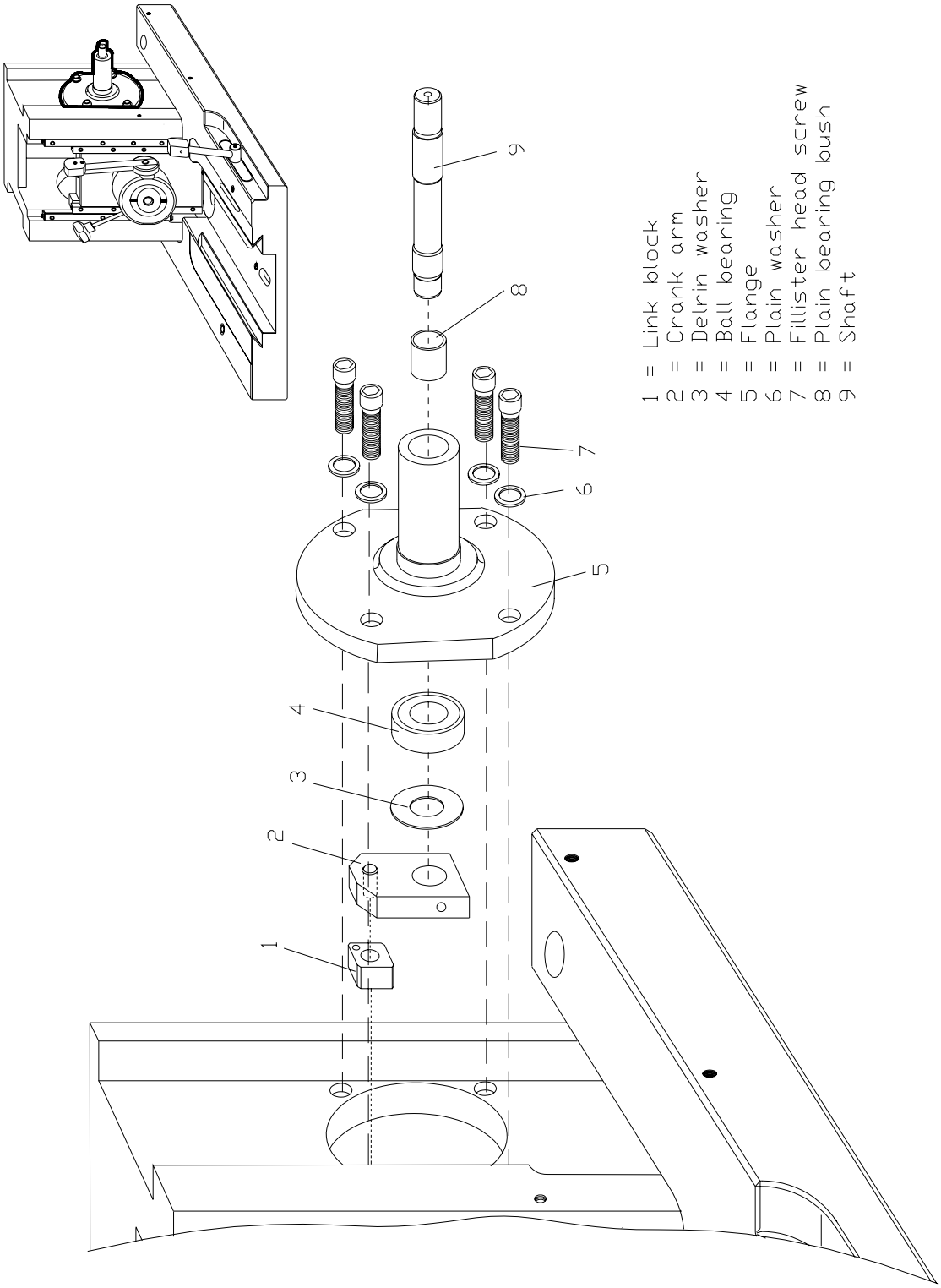

1 = Link block
2 = Crank arm
3 = Delrin washer
4 = Ball bearing
5 = Flange
6 = Plain washer
7 = Fillister head screw
8 = Plain bearing kush
9 = Shaft
1
2
3
4
5
6
7
8
9

Fig. 23a

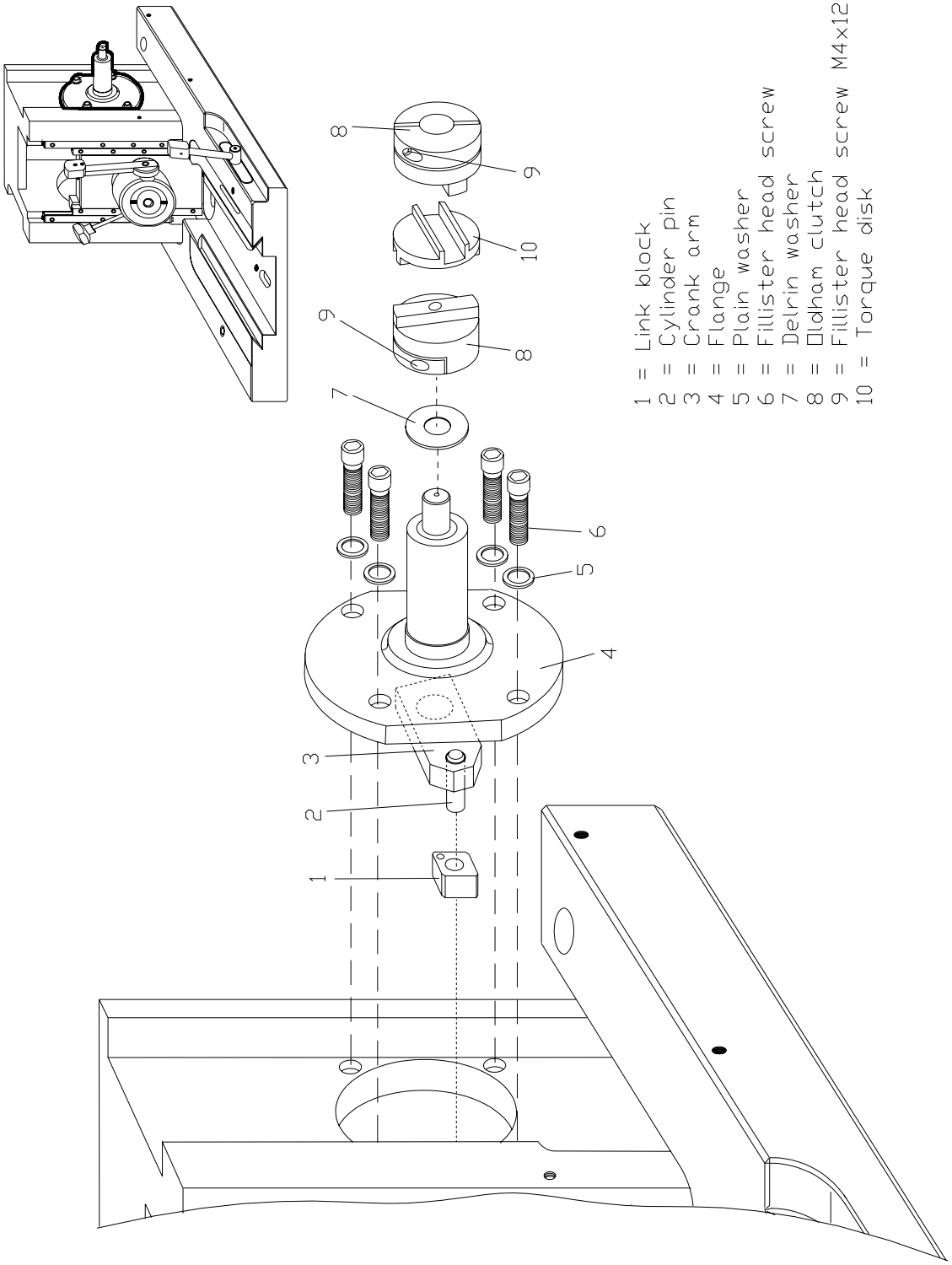

1 = Link block
2 = Cylinder pin
3 = Crank arm
4 = Flange
5 = Plain washer
6 = Fillister head screw
7 = Delrin washer
8 = Oldham clutch
9 = Fillister head screw M4x12
10 = Torque disk

Fig. 23b

9-10 Cross roller bearings

The cross roller bearings can only be exchanged in pairs.

Removal:

To dismount the cross roller bearings, first remove the microtome from the cryostat (see part 9-1).

Then unscrew the housing of the microtome.
The cross roller bearings (fig. 24.4 and 24.6) consist of 2 x 2 rails with a roller cage (fig. 24.12) with rollers each. One rail of each cross roller bearing pairs is screwed on the monobloc (fig. 24.2) and one on the frame (fig. 24.1).
Loosen all fastening screws (fig. 24.3 and 24.5) of the cross roller bearings. Then either the right or the left cross roller bearings can be removed.

Installation:

First pre-assemble the cross roller bearings on the monobloc. Note that the site of installation is clean and without burrs.
Tighten the fastening screws (fig. 24.3) of the two right rails and the rail on the left side of the monobloc. Only slightly tighten the screws (fig. 24.5) of the rail on the left side of the frame. Mediate the roller cages not touching top or bottom. Tighten the six threaded pins in the holes (fig. 24.9) with a torque of 6 Ncm using a torque wrench. During this setting the horizontal cylinder should always have the same position as the pin to be fastened. Then tighten the fastening screws (fig. 24.5) of the left rail. This rail cannot be moved anymore.
Then check the cross roller bearings by moving the horizontal cylinder up and downwards. To check the cross roller bearings again, loosen the six threaded pins in their holes (fig. 24.9) once more and tighten them with the above-mentioned torque. Again move the horizontal cylinder up and downwards and check for zero-backlash. Then mount the end pieces.

To exchange the right pair of cross roller bearings, the left pair must also be loosened. Adjustment is only possible via the left pair.

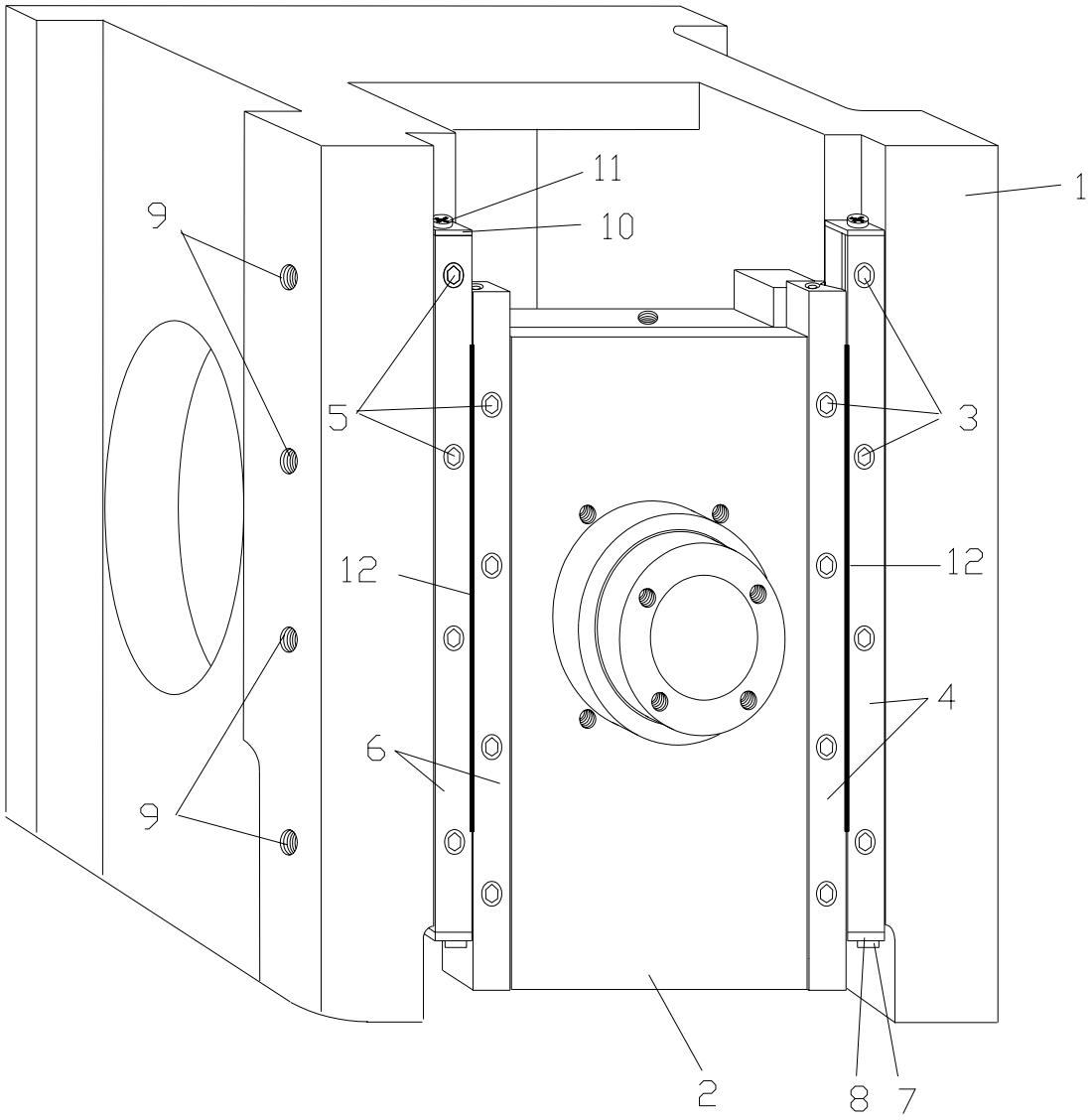


Fig. 24

1 = Frame
2 = Cylinder with guidance
3 = Fastening cross roller bearings
4 = Right cross roller bearings
5 = Fastening cross roller bearings
6 = Left cross roller bearings
7 = Fastening end piece
8 = End piece
9 = Hole to adjusting screws
10 = End piece
11 = Fastening end piece
12 = Roller cage

9-11 Pre-amplifier with flange for the automatic approach system

To be able to exchange the amplifier with flange, remove the microtome from the cryostat (see part 9-1).

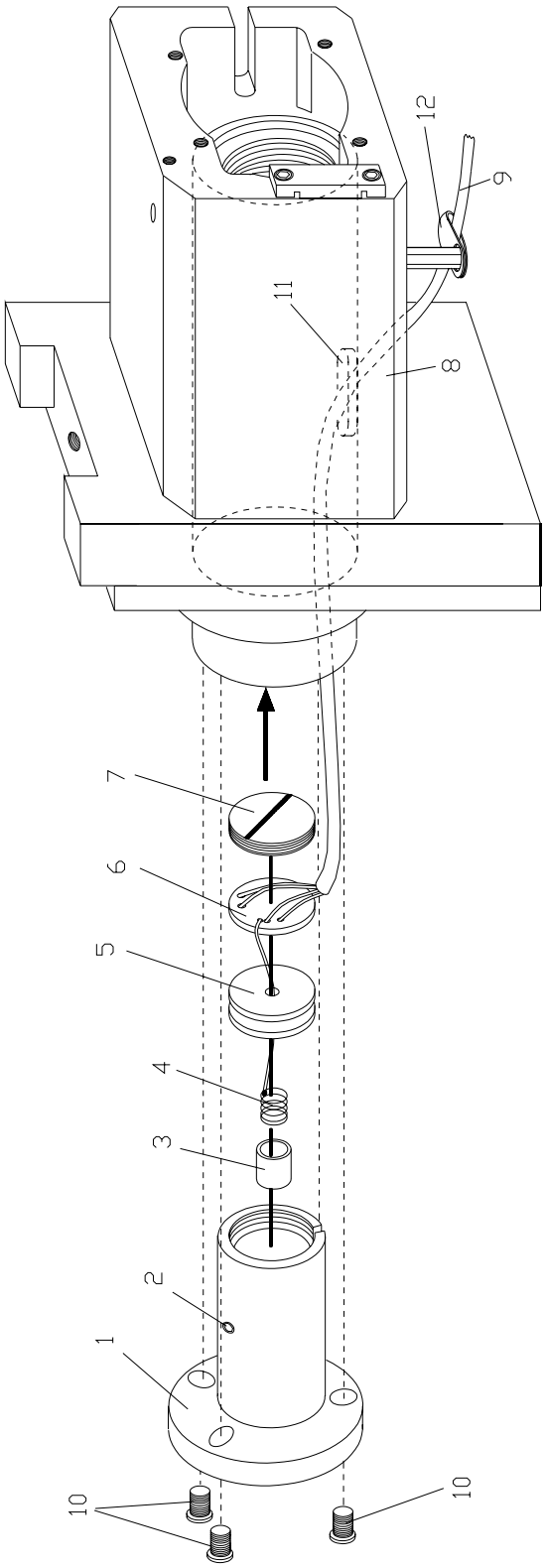
NOTE!
The amplifier with flange can only be exchange as a complete assembly and is available under cat. no. 642140.

To exchange the amplifier with flange, unscrew the cylinder head (fig. 3.17).

CAUTION!
For cryostats, which are equipped with an automatic approach system, only use an Allen screw M8x20, wrench size 6.
If a longer Allen screw is used, the amplifier with flange might be damaged.

Loosen the four fastening screws (fig. 21.13) on the rear side of the driving unit (fig. 21). Remove the cover angle (fig. 21.10) and loosen the connecting cable on CONN 3 (fig. 21.6). Before, however, mark the cable.
Loosen the strain relief (fig. 25.12) on the underside of the monobloc (fig. 25.8). Loosen the three fastening screws (fig. 25.10) and pull the amplifier with flange (fig. 25.) off the guide with bush (fig. 25.8).

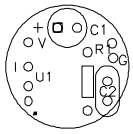
The installation of the amplifier with flange is carried out in reverse order.

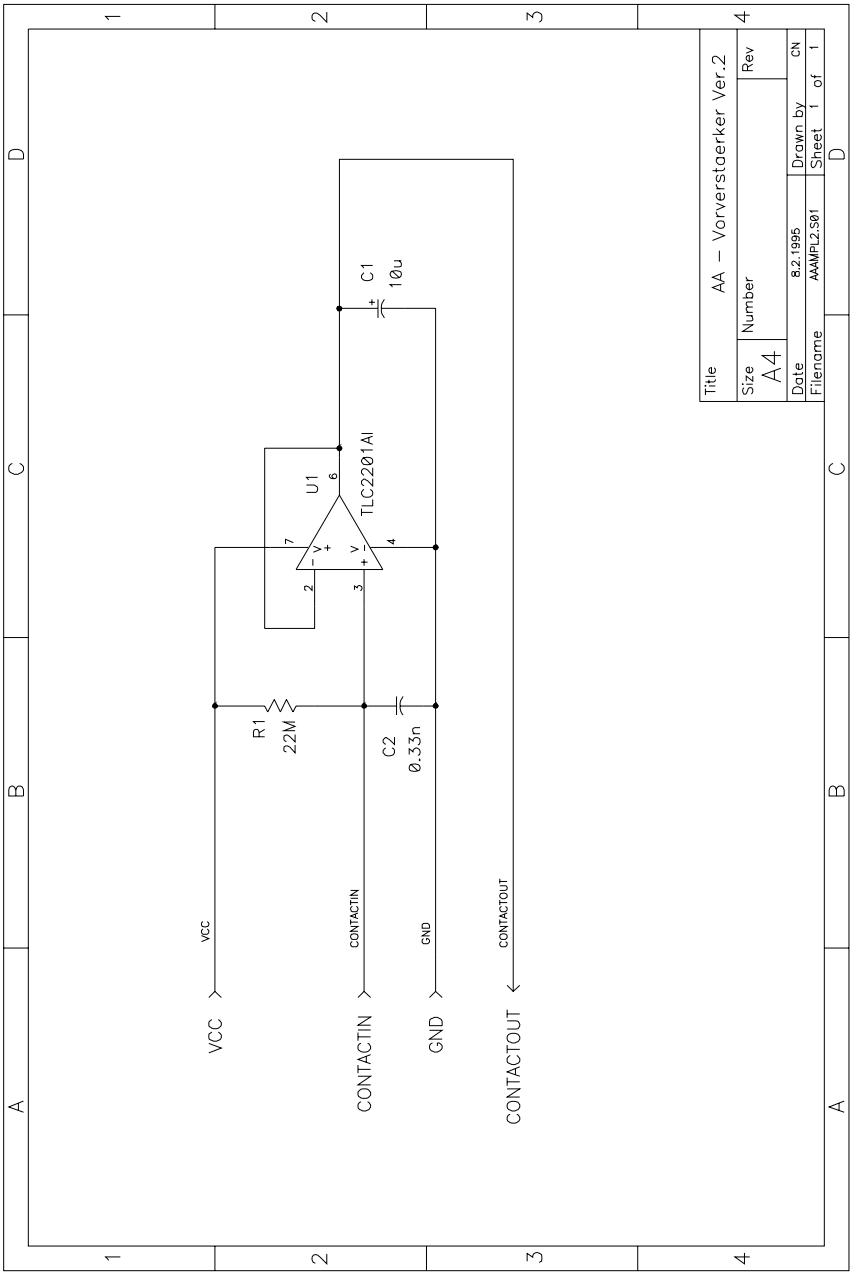


8 = Monobloc / guidance with bush
9 = Connecting line
10 = Fillister head screw
11 = Hole connecting line
12 = Strain relief

1 = Flange
2 = Threaded pin
3 = Spring bush
4 = Pressure spring
5 = Plate
6 = PC board AAAHPL2
7 = Cover

Fig. 25





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9-12 Chassis

To dismount the chassis (fig. 26.1), first loosen the twelve fastening screws of the rear wall (fig. 2.4) and remove the rear wall. Then pull off the protective conductor connection of the right (fig. 2.5) and left (fig. 2.2) side wall as well as the front wall (fig. 2.1).

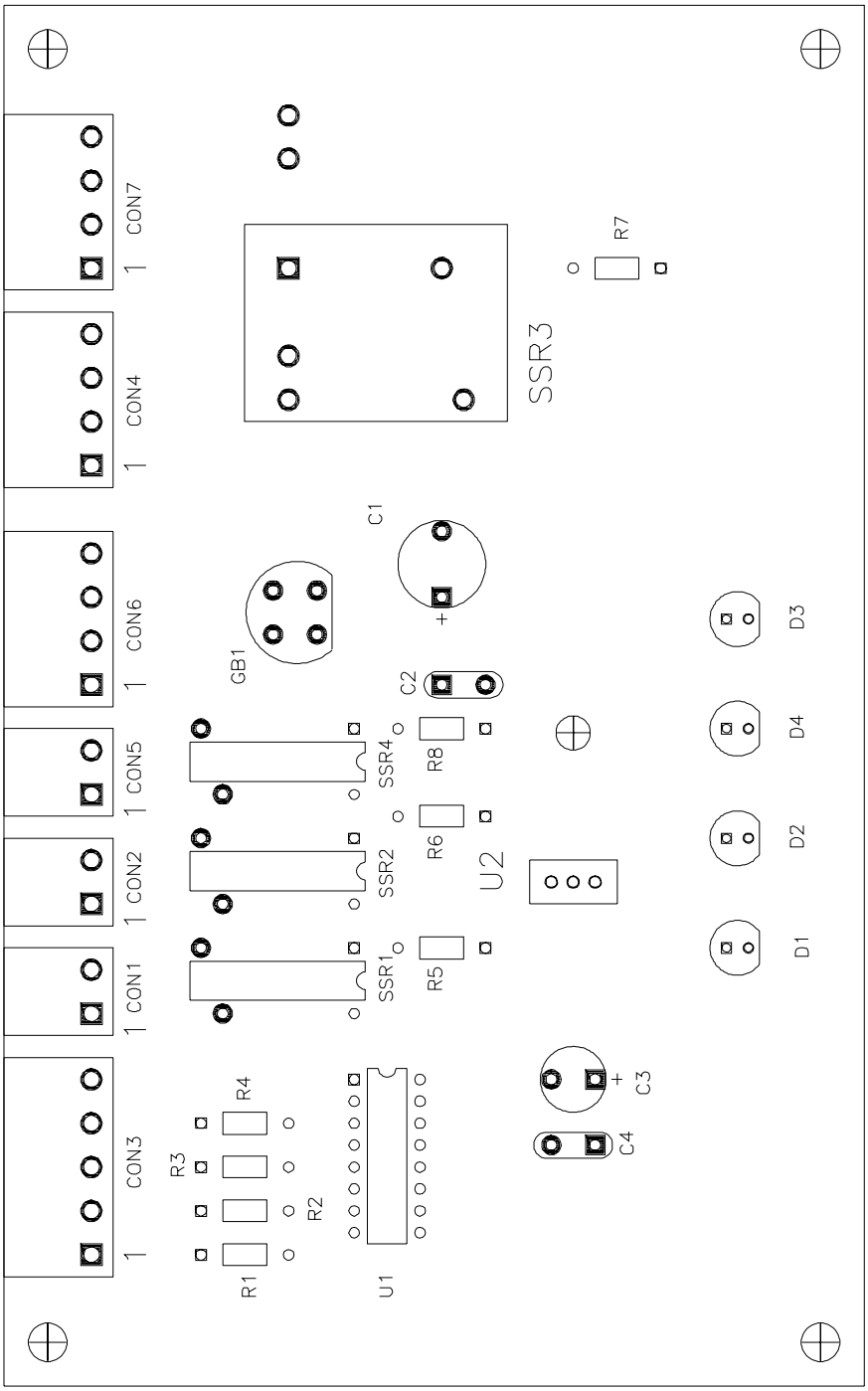
The chassis is fastened to the frame via three screws (fig. 26.29). Two screws are placed on the front edge of the chassis below the fuse holder (fig. 6a.14 to 6a.23). Another screw is placed behind the transformer T4 (fig. 26.28). After having loosened these screws, the chassis just sits the frame. To remove the chassis, slightly lift it and turn it somewhat in a clockwise direction.

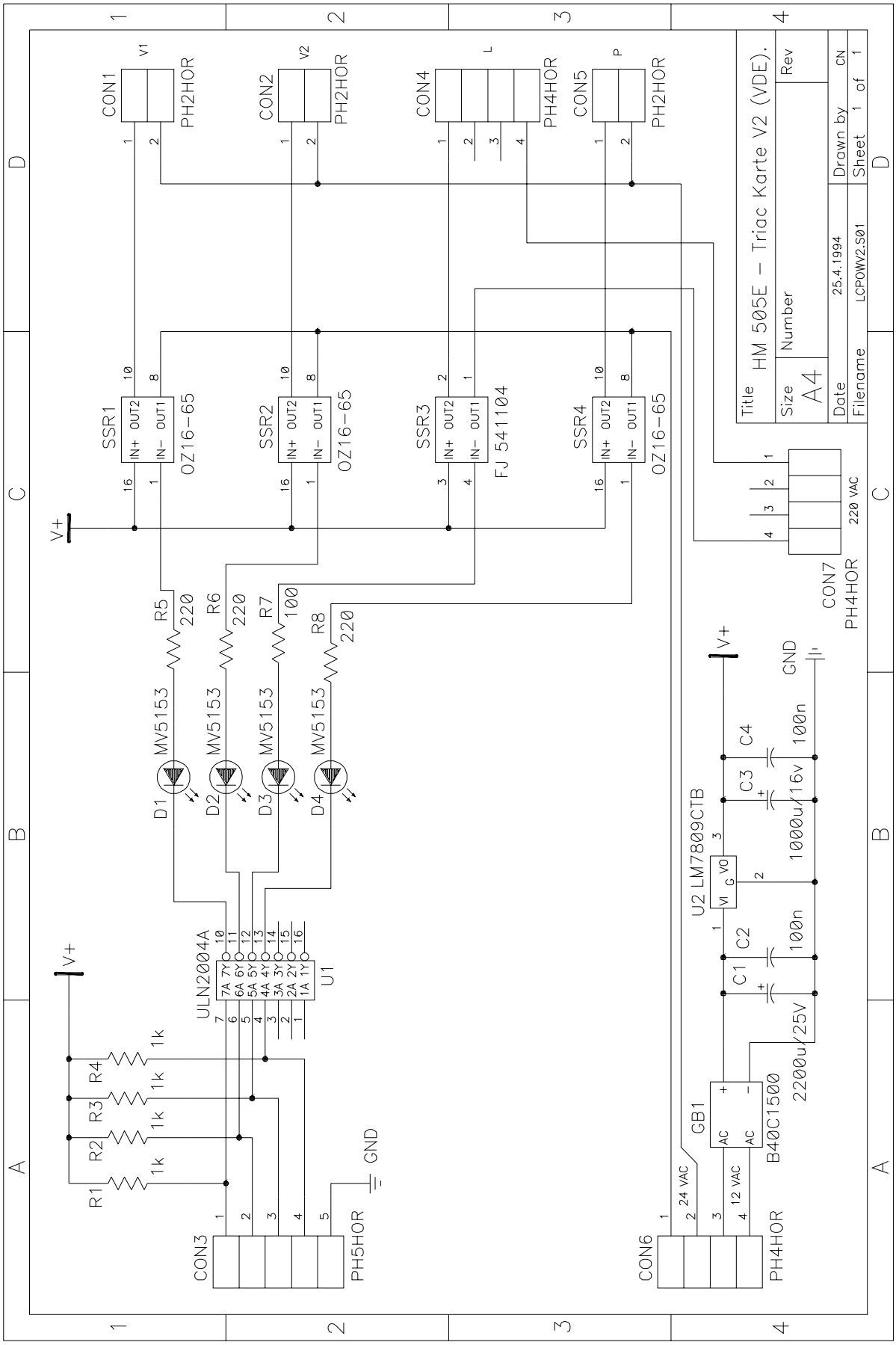
The installation is carried out in reverse order. After the installation please note that all protective conductors are plugged in their respective connections.

9-12-1 Triac board

After having removed the rear wall (fig. 2.4) of the instrument, pull all connectors off the board (fig. 7.20).
After having loosened the four fastening screws, remove the board.

The installation of the triac board is carried out in reverse order.





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9-13 Compressor

If a defective compressor has been noticed during the fault checking, please proceed as follows:

First turn off the cryostat and unplug the instrument. Now open the cryostat as described in part 4-2.

Removal of the defective refrigerantcompressor

CAUTION! This and all other work must only be carried out by authorized refrigeration technicians who have the corresponding tools and devices at their disposal!

Remove the electric connecting box on the compressor by unplugging the retaining clip. Remove relay with cable connection as well as capacitor (before discharge the capacitor). Connect the suction implement for the refrigerant on the filler neck of the compressor. Suck off the refrigerant on pressure and suction side each and dispose of it according to your national legal rules and regulations.

Loosen the fastening of the compressor. Unsolder the high and low pressure connections. Remove the compressor from the base plate.

Installation of a new compressor

Solder the filler neck of the defective compressor to the new one. Fasten the compressor onto the base plate. Solder in the high and low-pressure side.

NOTE!
Generally, the tube connections on the compressor must not be opened for more than 5 min. (Absorption of humidity of the oil). Carry out the soldering on the compressor with a copper solder (copper brazing solder no. 15 L-Ag according to DIN 8513, fluxing agent: F-SH1 paste/powder). Debris must not get into the tubing.

Filling the system with refrigerant

Connect vacuum pump with manometer battery or if necessary filling system on filler neck. It is absolutely necessary to suck off the system both on the suction as well as on the pressure side. A pressure of $\leq$ 1 mbar must be achieved.
The suction duration depends on the size of the connected vacuum pump (time is normally between 0,5 and 1 h). Carry out vacuum check. Possible increase of pressure should not be higher than 1 to 2 mbar within 2 min. If available, the system should be tested with dry nitrogen at a pressure of 20 bar before the suction process. If refrigerant is used as pressure checking medium, the system must be completely sucked off after the test with suitable instruments.

Establish the electric connections with the new capacitor as well as the new starting relay.

Fill the system with the refrigerant named on the type plate until the pressure increases to approx. 2 bar. To start the compressor, turn on the cryostat and set the set value to the maximum value (e.g. -35°C). Fill in the refrigerant named on the type plate with a tolerance of +/-5 g.

Characteristic of suction pressure change

After the filling process, there will be the following course of the suction pressure at +20°C ambient temperature.

The suction pressure falls to approx. 1,5 bar (abs), after approx. 3 to 4 h it decreases from 1,5 bar to 1 bar (abs). At high ambient temperatures (e.g. +30°C), these values are approx. by 0,15 bar higher. After 3 to 4 h, there will be temperatures in the evaporator of approx. min. -43°C to -45°C depending on the ambient temperature.

After this process, separate the filling line, unscrew the cap of the Schrader valve and complete the installation of the instrument accordingly.

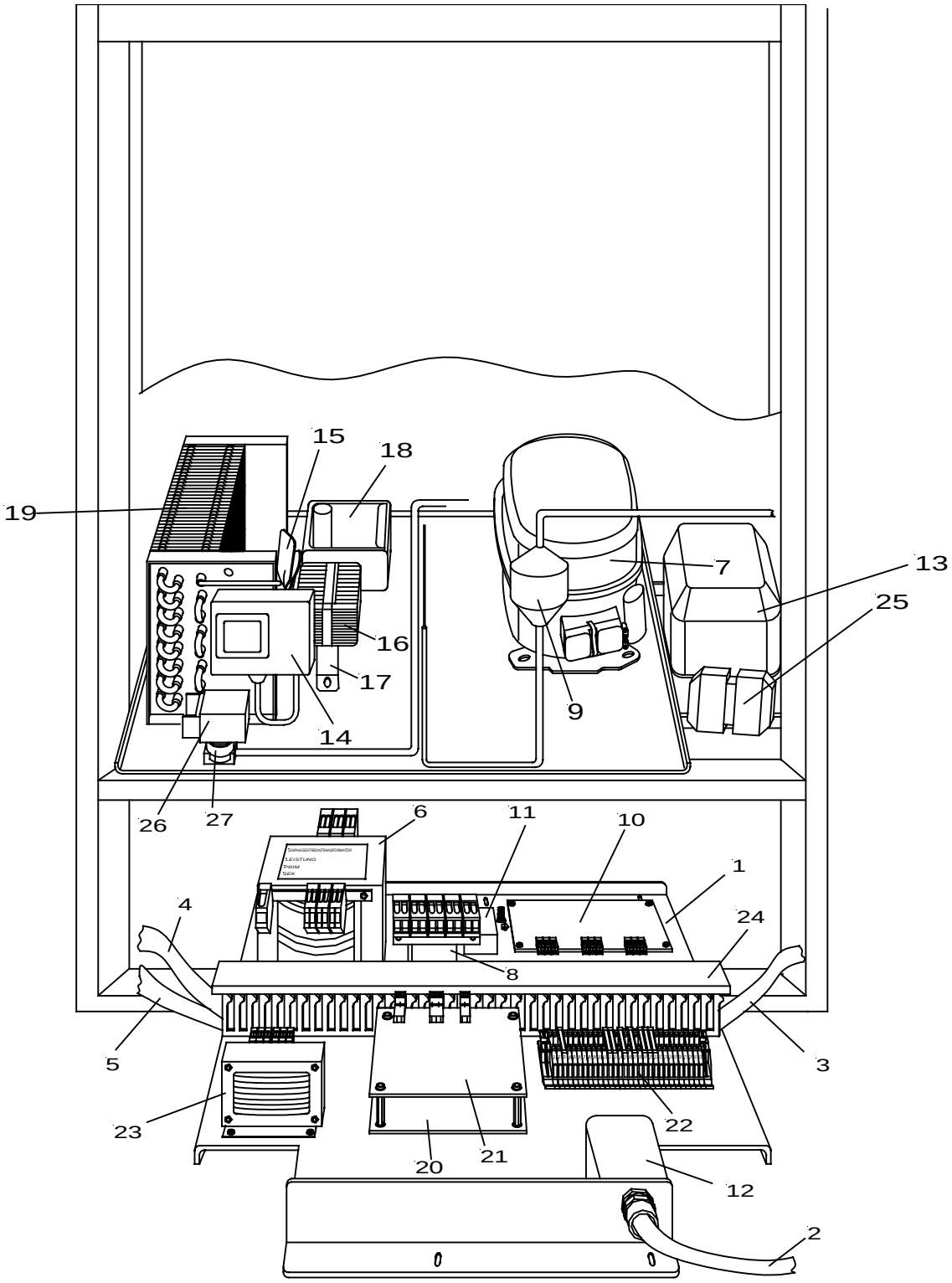

Fig. 26

Description for fig. 26

1 = Chassis
2 = Power cord
3 = Control cable
4 = Control cable
5 = Control cable
6 = Transformer T20
7 = Compressor
8 = Transformer T4a
9 = Filter dryer
10 = Vacuum control
11 = Relay
12 = Line filter
13 = Vacuum pump
14 = Pressure switch (autom. reset)
15 = Paddle
16 = Fan motor
17 = Fastening stand
18 = Collecting pan
19 = Condenser
20 = Triac board
21 = Peltier board
22 = Terminal block
23 = Transformer T38
24 = Cable channel
25 = Connection
26 = Magnetic coil
27 = Valve (defrosting)

9-14 Repair work on the cooling system

Repair work on the cooling system must generally be carried out very clean and thoroughly.

When exchanging parts, which require the opening of the cooling system (compressor, magnetic valve), please observe the following rules:

1. Do not evacuate the refrigerant into the open air. Generally, it must be sucked off with suitable and approved devices and disposed off according to your national legal regulations.
2. Close tube endings.
3. Open the connecting branch of the compressor and if possible solder it up within 5 - 10 min. (to avoid absorption of humidity of the oil).
4. When soldering on the magnetic valve, do not turn the flame of the burner towards the valve.
5. Before filling the system, evacuate for a sufficient time (depending on the efficiency of the pump 1 h at least).
6. Fill in the type and amount of refrigerant named on the type plate.
7. Normally, it is not necessary to exchange the filter dryer, as its capacity is sufficient enough. However, if the condenser fails due to electric motor damage (burned out coils), the filter dryer must be exchanged.

9-14-1 Pressures in the cooling system

After the filling and a durance run of approx. 3 h at a max. set temperature (-35°C), the following pressure is generated in the system at an ambient temperature of +20° to +25°C.

Suction pressure 1 bar abs (≅ -46°C R 404 a)
Condenser 13 to 14 bar (at a condensing temperature of ≅ +26 bis +30°C
Refrigerant R 404 a

9-14-2 Refrigerant

The fluorocarbon-free R 404 a is used as refrigerant.

As a substitute, the following types can be used:

CFC-free: R134a, R402a, R407a, R407b, R507
Containinig CFCs: R12, R502, R22

Except for type R507 and R502 you should reckon with a corresponding reduced cooling power.

CAUTION! The respective valid legal rules and regulations concerning the usage of refrigerants must strictly be observed!

It is not necessary to exchange to oil. The filling amount for R507, R22, R502 is 0,390 kg. For the other refrigerants, no values have been determined.

Part 10 Packing and dispatch

Lift the microtome cryostat HM 505 E onto the pallet (fig. 27.8) belonging to the original packing. Slightly tilt the cryostat sidewards and push the right (fig. 27.5) and left (fig. 27.6) foamed lower part one after the other under the cryostat.
Then place the upper foamed parts (fig. 27.3 and 27.4) onto the cryostat and pack the cryostat with the original packing (fig. 27.1). Secure the outer packing with the pallet by means of two tightening straps.
Return the instrument, including a detailed description of the faults, to MICROM International GmbH.
If the original packing is no longer available, please use a corresponding substitute packing made of **safe and stable material**, as MICROM International GmbH is not liable for any damage occurring during transport.

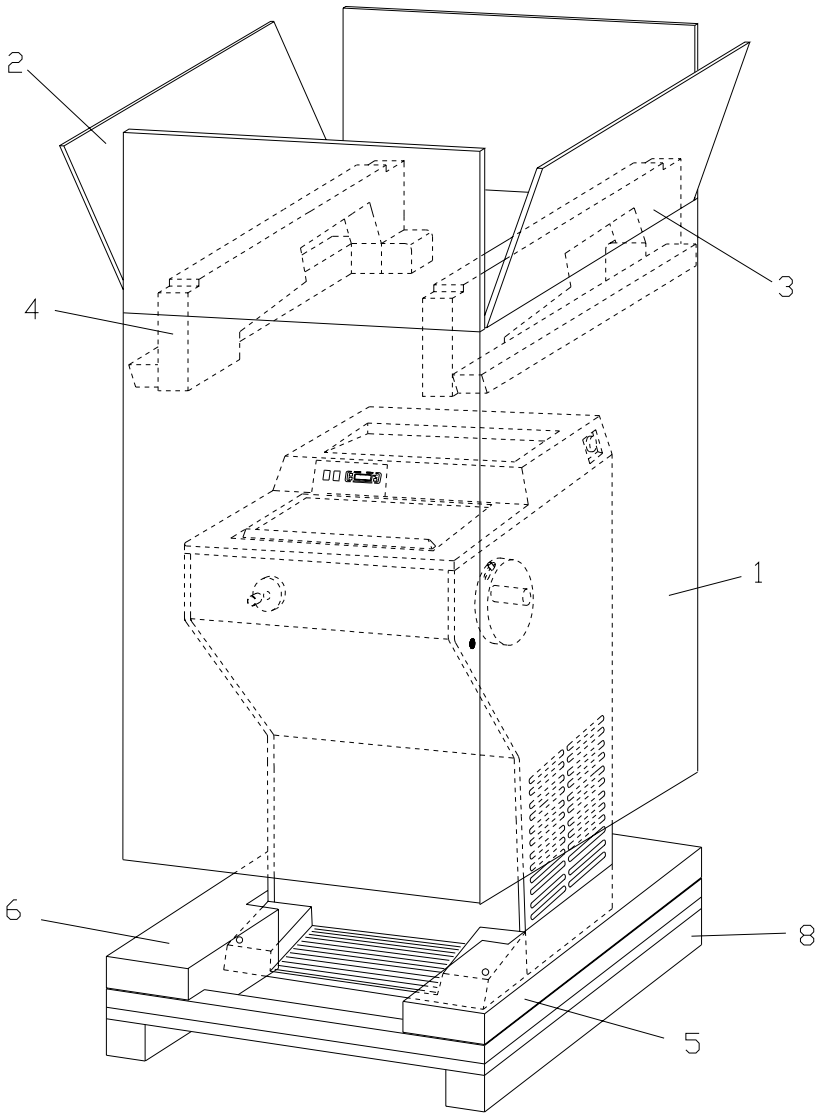

Fig. 27